

## Syllabus

### First Examination for the Degree of Bachelor of Pharmacy

#### SCHEME OF PAPERS

Sr. No.	Subject	Teaching Hrs./Week	Maximum Marks			Minimum Marks for Passing	Time Allowed for Examination Hrs.
			Sessional	Paper	Total		
1-T-1	Introduction to Pharmaceutics	2	20	80	100	45	3
1-P-1	Introduction to Pharmaceutics	3	30	70	100	50	4
1-T-2	Pharmaceutical Chemistry Physical	2	20	80	100	45	3
1-P-2	Pharmaceutical Chemistry Physical	3	30	70	100	50	4
1-T-3	Pharmaceutical Chemistry Inorganic	2	20	80	100	45	3
1-P-3	Pharmaceutical Chemistry Inorganic	3	30	70	100	50	4
1-T-4	Pharmaceutical Biology	2	20	80	100	45	3
1-P-4	Pharmaceutical Biology	3	30	70	100	50	4
1-T-5	Pharmaceutical Engineering- I	2	20	80	100	45	3
1-T-6	Human Anatomy and Physiology	2	20	80	100	45	3
1-P-6	Human Anatomy and Physiology	3	30	70	100	45	4
1-T-7	Computer Application	2	20	80	100	45	3
1-P-7	Computer Application	3	30	70	100	50	4

**B. Pharm. First Year**

**1-T-1 Introduction to Pharmaceutics**

1. Pharmacy profession: History code of pharmaceutical ethics. Pharmacy as a career, pharmaceutical education, pharmacy in relation to allied health profession, various systems of medicines. Introduction to pharmacopoeia.
2. Routes of drug administration : Classification of pharmaceutical dosage forms. Definition of solid, liquid, semisolid, gaseous and new only others system.
3. Definitions, general formulations, manufacturing procedures and official products of-  
Liquid solutions: Aromatic waters, syrups, spirit, elixirs, glycerites, lotion and liniments.  
Dispersed vehicles: Jellies, mucilage's, emulsions and suspensions, milks.
4. Extraction and Glenical Products: Principle and method of extraction, preparation of infusion, tinctures, dry and soft liquid extracts.
6. Pharmaceutical arithmetic: Dilution and concentration of solutions, calculation by allegation, proof spirits, isotonic solutions.
7. Study of following Pharmaceutical aids with their application: Colouring agent, flavouring agents, sweetening agents.

**1-P-1 Introduction to Pharmaceutics (Practical)**

Experiments based on Theory topics.

**1-T-2 Pharmaceutical Chemistry Physical**

1. Introduction
2. Atomic structure & wave mechanics.
3. Behaviour of Gases: Kinetic theory of gases, deviation from ideal behaviour and explanation.
4. The liquid state: Physical properties- surface tension, parachor, viscosity, refractive index, optical rotation, dipole moments and chemical constituents.
5. Solutions: Ideal and real solutions, solution of gases in liquid, collogative properties, partition coefficient, conductance and its measurements, Debye Huckel theory. Expression of concentration, ebulliscope and cryoscopic methods for determination of molecular weight. Osmosis, Liquid-liquid system, critical solution, temperature.
6. Thermodynamics: - The first, second and third laws of thermodynamics. Zeroth law, absolute temperature scale, thermochemical equations, free energy functions and applications.
7. Chemical equilibrium: - Homogeneous and Heterogeneous Law of mass action, Lechateller's principle. Hydrolysis of salts. Henderson Haesalbalch's equation.
8. Phase rule: - One and two component system of pharmaceutical interest.
9. Chemical kinetics: - Order of reaction, first and second order of reaction, determination of order of reaction. Theories of reaction kinetics, characteristics of homogeneous and heterogeneous catalysis, acid base and enzyme catalysis.
10. Quantum Mechanics: Postulate of quantum mechanics, operators in quantum mechanics, the schrodinger wave equation.
11. Nuclear and Radiation Chemistry :- Natural and artificial, their applications in the field of pharmacy

**1-P-2 Pharmaceutical Chemistry Physical (Practical)**

Experiments based on Theory topics.

**1-T-3 Pharmaceutical Chemistry Inorganic**

An outline of methods of preparation, uses, of the following classes of pharmaceuticals includes in pharmacopoeia

1. Acid & Bases: Buffers, water
2. Gastro intestinal Agents: Acidifying agents, antacids, protective & adsorbents, cathartics.
3. Major Intra & Extra cellular electrolytes: Physiological ions, Electrolytes used in replacement Theory, acid base balance and combination therapy.
4. Essential & trace elements: Transition elements & their compounds of pharmaceutical importance: Ion & haematinics, mineral supplements
5. Cationic & Anionic components of Inorganic drugs useful for systemic effects.
6. Topical Agents: Protective , Astringents, Ant infective

7. Inhalants, Expectorant and Respiratory stimulants
8. Dental products: Dentifrices, Anti carries Agent
9. Complexing & Chelating agents use in Therapy
10. Antidotes in poisoning
11. Pharmaceutical Aids.
12. Inorganic radio pharmaceuticals: Nuclear radio pharmaceutical, Clinical Application and dosage, hazards & precautions.
13. Miscellaneous Agents - Antioxidant

**1-P-3 Pharmaceutical Chemistry Inorganic (Practical)**

Experiments based on Theory topics.

**1-T-4 Pharmaceutical Biology**

1. Scope and significance of Biology and pharmaceutical Sciences. Modern concepts of Biology viz. molecular, Physiological and Biochemical aspects.
2. Biological classification, species and population, Biotic community, Biosphere
3. Method of classification of plants
4. Plant cell: It's structure and non-living inclusion, mitosis and meiosis, different types of plants tissue and their functions.
5. Morphology and history of root, stem, bark, wood, leaf, flower, fruit and seed . modification of root and stem.
6. General structure and life history of parasites as illustrated by amoeba. Entamoeba, trypanosome, plasmodium, taenia, and ascaris.
7. General structure and life history of insects like mosquito, housefly, silkworm and mites.
8. Plant Taxonomy: Study of the following families with special reference to medicinal important plants: papaveraceae, Ranunculaceae, Cruciferaeae, Apocyanaceae, Rutaceae, Umbelliferae, Rubiaceae, Solanaceae, Convolvulaceae, Scrophylariaceae, Labiaceae, Euphorbiaceae ,Liliaceae, Amarylidaceae, Singiberaceae, Dioscoraceae..
9. Introduction to microscopy (optical, electron, phase contrast, etc.)
10. Micro-chemical tests for cell wall and cell inclusions..
11. General structure, physiological life history and medico economic importance of: Bacteria, Penicillium, Claviceps, Yeast, Mushrooms and Lycopodium,
12. Preparation and preservation of herbarium sheets.

**1-P-4 Pharmaceutical Biology**

Experiments based on Theory topics

**1-T-5 Pharmaceutical Engineering- I**

1. Introduction to industrial Processing Unit Operations and Processes. Fundamental concept of material and energy balance Dimensional analysis.
2. Materials of pharmaceutical Plant construction: - Factors affecting the material selection for Pharmaceutical plants. Physical, Chemical and mechanical properties and uses of important materials and their alloys employed in the construction of pharmaceutical plants, heat and corrosion resistant alloys.
3. Corrosion and its prevention: - General considerations, types of corrosion, methods of reducing corrosion.
4. Industrial hazards and safety measures: - Mechanical chemical, electrical, fire and explosive hazards in pharmaceutical process, industries including inflammable gases and dusts. Safety measures in pharmaceutical plants and works.
5. Flow of fluids : Fluid static, manometers, Reynolds number and its significance, distribution of velocities across a pipe, Bernoulli's theorem and its applications. Fluid heads, friction losses, Enlargement and contraction losses, measurement of flow of fluids.
6. Transportation of material: - Solids: Types of conveyors. Belt conveyers, Chain conveyers screw conveyors, pneumatic conveyors and conveying of manufactured materials. Liquid: - pipes, pipe fittings, pumps and valves. Gases: - Fans, blowers, compressors and ejectors.
7. Process variables and elements of automatic process control, principles and instruments used in measurement of variables like temperature, pressure, flow level, moisture etc. Introduction to process control.
8. Filtration :- Mechanism of filtration, factors affecting filtration, selection of filters, study of filter media, and filter aids, classification of filters, filter press, leaf filters, continuous rotary filters, media filter, membrane filters, sterile filtration of liquids.

9. Centrifugation: - Theoretical consideration, principle of centrifugation, study of laboratory and large scale equipments and their applications. Size Reduction: - Mechanism of size reduction, factors affecting size reduction . pharmaceutical application, theory of size reduction .energy requirement, classification of equipment. Study of cutting rolls. Hammer mill, ball mill roller mill fluid energy mill colloid mill, selection of equipment's. Wet grinding .closed circuit grinding
10. Size separation: - Standards for powders, sieves and sieving equipment fluid classification methods sedimentation, Ceylon separator elutriation particle size distribution and its measurement representation of data.
11. Extraction: - Principles of solid - liquid and liquid - liquid extraction. Theories of extraction of drugs study of diffusion batteries, Door agitator, continuous counter current extraction system extraction towers, podbieliak extractor.
12. Mixing :- Fundamentals, mechanism of mixing, Factors influencing the selection of mixers, study of solid-solid, solid-liquid and liquid- liquid mixers used in pharmaceutical industry, ultrasonic mixers

#### **1-T-6 Human Anatomy and Physiology**

1. Scope of anatomy and physiology and basic terminology used in these subjects.
2. Structure of cell, its components and their functions.
3. Elementary tissue of the human body: Epithelial, connective, muscular and nervous tissues, their sub-type and their characteristics.
4. Osseous system: Structure, composition and functions of skeleton, classification of joints, type of movement of joints, disorders of joints.
5. Skeletal system: Gross anatomy and physiology of muscle contraction, physiological properties of skeletal muscle and their disorder.
6. Haemopoietic system: Composition and functions of blood and its elements, their disorder, blood groups and their significance, mechanism of coagulation.
7. The lymphatic system: Composition, formulation and circulation of lymph, disorder of lymph and lymphatic system. Basic Physiology and function of spleen.
8. The cardiovascular system: Basic anatomy of the heart. Physiology of heart, blood vessels and circulation. Basic understanding of cardiac cycle, heart sound and electrocardiogram, blood pressure and its regulation. Outline of cardiovascular disorder like hypertension, hypotension, atherosclerosis, angina, myocardial infarction, congestive heart failure and cardiac arrhythmias.
9. The digestive system: Gross anatomy of the gastro-intestinal tract. Functions of its different parts including those of liver, pancreas and gall bladder, various gastrointestinal secretions and their role in the absorption and digestion of food. Disorders of digestive system.
10. The respiratory system: Anatomy of respiratory organs, functions of respiration, mechanism and regulation of respiration, respiratory volumes and vital capacity.
11. The urinary system: Various parts, structure and functions of the kidney, and urinary tract. Physiology of urine formation and acid-base balance. Diseases of the urinary system.
12. The reproductive system: Male and Female reproductive system and their hormones, physiology of menstruation, coitus and fertilization. Sex differentiation, spermatogenesis& oogenesis. Y its maintenance and parturition.
13. Endocrine system: Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenals, pancreas, testes and ovary, their hormones and functions.
14. The special senses- Hearing and the ear, balance and the ear, sight and the eye, sense of smell, sense of taste, diseases of the ear, disease of the eye, refractive errors of the eye. The skin- Structure of skin, Functions of skin, wound healing. Disorders of the skin.

#### **1-P-6 Human Anatomy and Physiology ( Practical)**

Experiments based on Theory topics

#### **1-T-7 Computer Applications**

1. Digital Electronics : Number system, Review of logic gates, Boolean algebra, Combinational circuits, Decoders and Multiplexers, Flip-Flops, Binary Counters, Shift registers, Data representation, fixed point and floating point representation and other binary codes, half adder, full adder, subtractor.
2. Introduction to Computers : Computer System Characteristics and Capabilities: Speed, Accuracy, Reliability, Memory capability, Repeatability. Computer Hardware: Block Diagram of a Computer. Types of Computers: Analog, Digital, Hybrid General and Special Purpose Computers. Computer

Generations: Characteristics of Computer Generations Computer Systems – Micros, Minis & Mainframes. Introduction to a PC: The IBM Personal Computer Types of PC systems PC, XT & AT Pentium PC's Limitations of Micro Computer.

3. Computer Organization: Introduction to Input Devices: Categorizing Input Hardware, Keyboard, and Direct Entry – Card Readers, Scanning Devices – O.M.R., Character Readers, MICR, Smart Cards, Voice Input Devices, Pointing Devices – Mouse, Light Pen. Storage Devices: Storage Fundamentals, Primary and Secondary Storage, Hard Disks, Disk Cartridges, Direct Access Storage Devices for large Computer systems, Mass storage systems and Optical Disks, CD ROM. Central Processing Unit: The Microprocessor, control unit, A.L.U., Registers, Buses, Main Memory, Main Memory (RAM) for microcomputers, Read Only Memory (ROM). Computer Output: Hardcopy and Softcopy, Impact Printers, Non-Impact Printers, Plotters, Flat Screen Technologies.
4. Computer Software's System Software: System software Vs. Application Software, Types of System Software, Introduction and Types of Operating Systems programs, Booting Loader, Diagnostic Tests, Operating Systems Executive, BIOS, Utility Programs, File Maintenance, Language Processors, Assembler, Compiler & Interpreter. Application Software: Types of Application Software, Difference between Program and Packages. Disk Operating System: Internal & External Commands, Unix Commands.
5. Networking Concepts: Types of networks design structures; LAN/MAN/WAN; Advantages and limitations. Internet and its Basic Concepts; The Mechanism of the Internet. HTML Basics & Web Site Design Principles – Exploring the World Wide Web: Browsing and Information retrieval, Designing Web page: Concept of a Web Site, Web Standards, What is HTML HTML document/file, HTML Editor, Elements in HTML Documents, HTML Tags, Basic HTML Tags, Extensible Markup Language (XML), HTML Document Structure: Head Section, Body Section: -Body elements, Background, TEXT BODY element, ADDRESS; BLOCKQUOTE; TABLE; COMMENTS in HTML, CHARACTER Emphasis Modes, Logical & Physical Styles, Netscape, Microsoft and Advanced Standard Elements List, FONT, BASEFONT and CENTER. Image, Internal and External Linking between WebPages, HTML Forms.
6. Computer Applications in Pharmaceuticals & clinical studies.
7. Orientation of Pharmacy Software.

**1-P-7 Computer Applications (Practical)**

Experiments based on Theory topics.

**Second Examination for the Degree of Bachelor of Pharmacy**

SCHEME OF PAPERS

Sr. No.	Subject	Teaching Hrs./Week	Maximum Marks			Minimum Marks for Passing	Time Allowed for Examination Hrs.
			Sessional	Paper	Total		
2-T-1	Modern Dispensing Pharmacy	2	20	80	100	45	3
2-P-1	Modern Dispensing Pharmacy	3	30	70	100	50	4
2-T-2	Pharmaceutical Chemistry Organic	2	20	80	100	45	3
2-P-2	Pharmaceutical Chemistry Organic	3	30	70	100	50	4
2-T-3	Drug Analysis- I	2	20	80	100	45	3
2-P-3	Drug Analysis- I	3	30	70	100	50	4
2-T-4	Pharmacognosy –I	2	20	80	100	45	3
2-P-4	Pharmacognosy –I	3	30	70	100	45	4
2-T-5	Physical Pharmacy	2	20	80	100	45	3

2-P-5	Physical Pharmacy	3	30	70	100	50	4
2-T-6	Pharmaceutical Jurisprudence	2	20	80	100	45	3
2-T-7	Pharmaceutical Engg. – II	2	20	80	100	45	3
2-P-7	Pharmaceutical Engg. - II	3	30	70	100	50	4
2-T-8	Applied Mathematics	3	20	80	100	45	3

### B. Pharm. Second Year

#### 2-T-1 Modern Dispensing Pharmacy

1. History, Definition and scope.
2. Prescription: Handling of prescription, source of errors in prescription, parts of prescription, compounding of prescription care required in dispensing procedures, including labelling of dispensed products.
3. Latin terms: knowledge of commonly used Latin terms in prescription and their translation into English.
4. Forms of administering medicines. Principles involved and procedures adopted in dispensing of : Typical prescriptions like mixers, solutions, emulsions, creams ointments, powders, capsules, pastes, jellies, suppositories , ophthalmic, pastilles, Jizenges, pills, lotions, limmets inhalation , paints, sprays table triturates etc.
5. Incompatibilities: Physical and chemical incompatibilities, inorganic incompatibilities including incompatibilities of metals and thie salts, non-metal acids, alcohols, organic incompatibilities, Purine bases , alkaloids, pyrazolone derivatives, amino acids, quate4rnary ammonium compounds, carbohydrates, glycosides, anaesthetics, dyes, surface active agents, correction of incompatibilities. Therapeutic incompatibilities.
6. Dispensing calculations. Basis of posology, calculation o doses for infants, adults and elderly patients; Detection of overdoses in prescription, knowledge of prophylactic and therapeutic doses with route of administration. Different systems of weight and measurements and their interconversions.
7. Surgical products: Definition, primary wound dressing, absorbents, surgical cotton, surgical gauze's etc., bandages, adhesive tape, protective cellulose haemostatics, official dressings, absorbable and non absorbable sutures, ligatures and catgut. Medical prosthetics and organ replacement materials.
8. Packaging of Pharmaceutical Products : Packaging components, types, specification and methods of evaluation stability aspects of packaging. Packaging equipment's, factors influencing choice of containers, legal and other official requirements for containers, package testing.

#### 1-P-1 Modern Dispensing Pharmacy (Practical)

Experiments based on Theory topics.

#### 2-T-2 Pharmaceutical Chemistry Organic

The subject of organic chemistry will be treated in its modern perspective keeping for the sake of convenience, the usual classification of organic compounds.

1. Structure and properties: Atomic structure, Atomic orbital, Molecular orbital theory , wave equation, Molecular orbital, Bonding and ant bonding orbital, Covalent bond. Hybrid orbital, Intermolecular forces, Bond dissociation energy, Polarity of bonds, Polarity of molecules, structure and physical properties, Intermolecular forces, Acids and bases.
2. Stereochemistry : Isomerism and nomenclature and associated physiochemical properties, optical activity, stereoisomerism, specification of configuration, Reactions involving stereoisomer, chirality, chiral reagents conformations.
3. Structure, Nomenclature, Preparation and Reactions of : Alkanes, Alkenes, Alkynes, Cycloalkanes, Dienes, Benzene, Polynuclear aromatic compounds , Arenes, Alkyl halides, Alcohols, Ethers, Epoxides, Amines, Phenols, Aldehydes and ketones, Carboxylic acids, Functional derivative of carboxylic acids, Reactive intimidates - carbocations, carbanions, carbons, nitrate and nitremum ions.
4. Heterocyclic Compounds : Chemistry, preparations and properties of some important heterocyclic containing 3, 4, 5, 6 & 7 atoms with one or two heteroatom like, O, N, S.
5. Chemistry of lipids, Carbohydrates, Proteins and Nucleic acids.

#### 2-P-2 Pharmaceutical Chemistry Organic (Practical)

Experiments based on Theory topics.

### 2-T-3 Drug Analysis –I

1. Introduction
2. Chemical Purity and its control- Introduction, the source of impurities in pharmaceuticals, standardization of pharmaceutical chemicals and formulated products, pharmacopoeial standards, identification, measurement of physical constraint, assay, limit test for metallic impurities, limit tests for acid radical impurities, limit tests for non-metallic impurities, the control of organic impurity in medicinal substances.
3. Registration & Assessment of Medicine- Introduction, clinical trial applications, product licence applications.
4. Significance of quantitative analysis in quality control: Different techniques of analysis, preliminaries and definitions, significant figures, rules for retaining significant digits, types of errors, mean deviation, standard deviation, statistical treatment of small data sets, selection of sample, precision and accuracy.
5. The Theoretical basis of quantitative analysis- Acid- base titrations, precipitation and complex formation, and oxidation-reduction titration.
6. Technique of quantitative analysis- General information, balances, weighing the sample, technique of volumetric analysis, technique of gravimetric analysis, variables in quantitative analysis.
7. Acidimetry and Alkalimetry- Standard volumetric solutions, direct titration of strong acid, direct titration of weak acids, direct titration of strong bases, direct titration of weak bases, back titration, back titrations with blank determination, determination of organically combined nitrogen.
8. Titration in non-aqueous solvents-Theory, titration of alkali metal salts of organic acids, titration of amines and amine salts of organic acids, titration of halogen acid salts of organic acid substances, aquametry.
9. Oxidation -reduction titrations- Introduction, determination involving the use of potassium permanganate solution, direct titration with iodine, iodine- sodium thiosulphate titrations, iodine value of fixed oils, potassium iodate titrations, ammonium cerium (IV) sulphate titration.
10. Precipitation & complexometric method- Argentimetric titration, ammonium thiocyanate titration of silver salts, ammonium thiocyanate titration of mercury compounds, theory of complexometric analysis, end point detection in complexometric v titration using pM indicators, complexometric methods, direct titration with disodium edetate, back- titration with disodium edetate, displacement of one complex by another, miscellaneous complexometric methods, gravimetric methods.
11. Solvent extraction methods- Theory, determination of the salts of organic acids and bases, determination of alkaloids in crude drugs and galenicals, determination of acids in crude drugs and galenicals, determination of unsaponifiable mater, indicator extraction titrations.
12. Miscellaneous methods- Determination of cineole ,Determination of ethanol in liquid galenicals, Mercurimetric titration, determination of methoxyl, Oxygen flask Combustion, determination of phenols as alkali- soluble matter, sodium nitrite titration, Enzymes in pharmaceutical analysis, microbiological assays, biological tests on animals.
13. Analysis of medicaments in formulation.- Introduction, quality control of formulated products, sterility testing of pharmaceutical products, microbial contamination of formulated products, aerosol inhalations, capsules, creams, emulsions, eye drops, injections, lozenges, mixtures, ointments, suppositories, tablets, radiopharmaceuticals.

### 2-P-3 Drug Analysis –I (Practical)

Experiments based on Theory topics.

### 2-T-4 Pharmacognosy-I

1. Definition, history, scope and development of Pharmacognosy.
2. Sources of drugs: Biological marine, mineral and plant tissue cultures as sources of drugs.
3. Classification of drugs: e.g. Alphabetical, morphological, taxonomical, chemical and pharmacological.
4. Quality control of crude drugs : Adulteration of crude drugs and their detection by organoleptic , microscope, physical, chemical and biological methods of evaluation.
5. Systematic pharmacognostic study of following:
  - a. Carbohydrates and derived products: Agar, Guar gum, acacia. Honey, Isabgol, Pectin Starch, and Tragacanth.
  - b. Lipids: Bees wax, Castor oil, Cocoa butter, Cod-liver oil, Linseed oil, shark liver oil and wool fat.

- C. Resins: Study of drugs containing Resins and Resin combination like colophony, podophyllum, cannabis, capsicum, asafoetida, balsam of tolu, balsam of Peru, benzoin, turmeric, ginger.
- d. Tannins: Study of tannins and tannin containing drugs like Gambier, black catechu, gall and myrobalan.
- e. Volatile Oils : General methods of obtaining volatile oils from plants, Study of volatile oils of Mentha, Coriander, Cinnamon, Lemon peel Orange peel, Lemon grass, Citronella, Caraway, Dill, Clove, Fennel, Nutmeg, Eucalyptus, Cardamom, Valerian, Sandal wood,.
- f. Fibres: Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass wool polyester and asbestos.
- g. Pharmaceutical aids: Study of pharmaceutical aids like talc, dratomite, kaolin, bentonite, gelatine and natural colours.

#### 2-P-4 Pharmacognosy-I (Practical)

Experiments based on Theory topics.

#### 2-T-5 Physical Pharmacy

1. Introduction of Physical Pharmacy
2. States of Matter:- Gases & Liquids- Introduction, Real gases, Liquefaction of gases, Solids-Crystallisation, Polymorphism: Definition, different shapes of polymorphs, examples and its applications to Pharmacy,
3. Thermo chemistry : exothermic and endothermic reactions,
4. Physical Properties of Drug Molecule - Additive, constitutive and colligative properties; Dielectric constant, its significance to pharmacy.
5. Solutions of non electrolytes- Properties and types of solutions, boiling point and boiling point diagrams, Lowering of vapour pressure, osmotic pressure-Semi permeable membrane and osmotic pressure, measurement of osmotic pressure,
6. Solutions of electrolytes - Electrolysis ; Conductance : Equivalent and specific conductance.
7. Solubility and Distribution Phenomenon - General principles, types of solvents; solubility of salts ; solubility of slightly soluble electrolyte, solubility of weak electrolyte-influence of pH, influence of surfactants; distribution coefficient (Nernst coefficient) ,co-solvency.
8. Application of Chemical Kinetics: Arrhenius equation and shelf life determination, Theories of reaction rate, Accelerated stability studies : Introduction to, conditions used in studying and purpose of studying.
9. Interfacial Phenomenon- Surface tension and surface free Energy ; measurement of surface and interfacial tension, spreading of liquids; adsorption at liquid interfaces, HLB-determination and importance with respect to suspension and emulsion, adsorption on solid surfaces, measurement of surface free area, its significance and importance, electrical double layer, Nernst and Zeta potential, effects of electrolytes, importance with respect to suspension emulsions.
10. Colloids- Introduction, definition, types size and methods of preparation, differences between true, colloidal and coarse suspensions; optical and Kinetic properties : Electro kinetic phenomenon-electrophoresis, electro-osmosis, Donan, membrane equilibrium and its applications; stability of colloidal systems, sensitisation and protective colloids; solubilisation of colloids
11. Rheology- Introduction – Newtonian and Non Newtonian system, viscosity measurements, thixotropy and its pharmaceutical significance; applications of Rheology to pharmacy.
12. Micromeritics : Introduction to fundamental and derived properties, methods to determine particle size, shape and surface area, density and bulkiness, flow properties compaction,
13. Diffusion and dissolution- Introduction, related phenomenon like dialysis, osmosis filtration, dissolution studies apparatus, Noyes Whitney equation, Hixon Crowell cube root law. Complexation.
14. Coarse dispersion - suspension, emulsion.

#### 2-P-5 Physical Pharmacy (Practical)

Experiments based on Theory topics.

#### 2-T-6 Pharmaceutical Jurisprudence

1. Introduction
  - a. Pharmaceutical Legislations – A brief review
  - b. Drugs & Pharmaceutical Industry – A brief review
  - c. Pharmaceutical Education – A brief review

2. An elaborate (practical oriented) study of the following
  - a. Pharmaceutical Ethics
  - b. Pharmacy Act 1948
  - c. Drugs and Cosmetics Act 1940 and Rules 1945
  - d. Medicinal & Toilet Preparations (Excise Duties) Act 1955
  - e. Narcotic Drugs & Psychotropic Substances Act 1985 & Rules.
  - f. Drugs Price Control Order.
3. A brief study of the following with special reference to the main provisions.
  - a. Poisons Act 1919
  - b. Drugs and Magic Remedies (Objectionable Advertisements) Act 1954
  - c. Medical Termination of Pregnancy Act 1970 & Rules 1975
  - d. Prevention of Cruelty to Animals Act 1960
  - e. States Shops & Establishment Act & Rules.
  - f. Insecticides Act 1968
  - g. AICTE Act 1987
  - h. Factories Act 1948
  - i. Minimum Wages Act 1948
  - j. Patents Act 1970.
4. A brief study of the various prescription/Non-prescription Products, Medical/Surgical accessories, Diagnostic aids, appliances available in the market.  
**Note: - The teaching off all the above acts should cover the latest amendments.**

## 2-T-7 Pharmaceutical Engineering -II

A study of following topics with particular reference to pharmaceutical industry.

1. Heat transfer- Heat transfer mechanisms. Heat transfer by conduction. Fourier's law compound resistance in series, heat flow through a cylinder, conduction, convection through fluids, Natural and forced convection. Surface coefficients, overall heat transfer coefficients. Radiation. Concepts of black and gray body, Heaters, heat exchangers, Inductive heating. Introduction to various types of heating media and fuels, steam as heating medium, properties and uses of steam. Steam traps, heating by electricity. Insulations types and selection of insulators.
2. Evaporation: - Factors affecting evaporation, types of evaporators study of evaporating pan evaporating still, short tube evaporators forced circulation evaporators, film evaporators Evaporator accessorie Evaporators capacity, heat and material balances multiple effect evaporation capacity of multiple effect evaporators under reduced pressure.
3. Distillation: - General theory applied to binary mixtures boiling point and equilibrium diagrams Raoult's law and Henery's law, constant boiling mixtures. Equilibrium distillations, differential distillations, rectification, construction of rectifying columns. Enthalpy composition diagram reflux ratio, McCabe Thiele methods for calculation of theoretical plates efficiency, Steam distillation, Molecular distillation and its applications.
4. Humidity and air conditioning :- Definition of various terms, psychometric charts, wet bulb theory, determination of humidity, methods of increasing and decreasing humidity, air conditioning, cooling towers, importance of humidity and its control.
5. Refrigeration :- General considerations, coefficient of performance, capacity of a refrigerating unit, compression and absorption types of refrigeration cycle, choice of refrigerate, application in pharmacy.
6. Drying : Introduction, theory of drying rate of drying, classification of dryers, Vacuum spray, tray, fluidised bed dryers, Principle of freeze drying and freeze dryers,
7. Crystallisation: - Crystal forms and crystal habit solubility curves theory of crystallisation, nucleation and crystal growth material and energy balances, Classification, principle underlying the design and operation of tank. Swenson Walker, Crystal and vacuum type crystallizers.
8. Gas absorption: - Tower packing properties and types of packing materials for tower, tower construction, pressure drop through packed towers, mass transfer coefficients, HETP.
9. Compaction and compression :- Measurement of punch forces, transmission of forces through powders distribution of forces, acting within the powder mass, effect of pressure on relative volume, Lubrication of the die wall, adhesion and cohesion of particles, strength of granules, factors affecting the strength of tablets.
10. Study of principle underlying the design and operation of various machines employed in the small scale and large scale production of tablets, capsules, ointments, liquid orals and parenterals.
11. Pilot plant scale up Techniques: - Concept of pilot plant. Pilot plant - scale up techniques in pharmaceuticals.

**2-P-7 Pharmaceutical Engineering –II (Practical)**

Experiments based on Theory topics

**2-T-8 Applied Mathematics**

1. Algebra - Arithmetical, Geometrical and Harmonical progressions. Permutations and combinations; binomial theorem with positive integral index, Logarithmic and Exponential series.
2. Trigonometry : Sum and difference of sine, cosine, tangent etc. of two angles, general expression of simple trigonometrical equations, The relation between sides and angles of a triangle solutions of triangles, logarithms and the use of log table.
3. Co-ordinate Geometry: Rectangular co-ordinate axis, distance between two points, co-ordinate of the point dividing the line joining two points in a given ratio (Internally and externally). Equations of straight line, Parallel & perpendicular to a given straight line point angle between two straight line. Equations of a straight line- Equations of a straight line passing through a given point. Length of a perpendicular from a given straight line, General equation of the first degree, General equation of 3 circles. Tangents and Normal to the circle. Equation of a parabola and ellipse.
4. Differential equations : Revision of integral calculus, definition and formation of differential equations, equations of first order and first degree, variable separable, homogeneous and linear differential equations and equations reducible to such types, linear differential equations of order greater than one with constant coefficients, complementary function and particular integral, simultaneous linear differential equations, pharmaceutical applications.
5. Laplace transforms: Definition, transforms of elementary functions, properties of linearity and shifting, inverse laplace transforms, transforms of derivatives, solution of ordinary and simultaneous differential equations.
6. Biometrics : Significant digits bend rounding of numbers, data collection, random and non-random sampling methods, sample size, data organization, diagrammatic representation of data, bar, pie, 2-D and 3-D diagrams, measures of central tendency, measures of dispersion , Standard Deviation and standard error of means, coefficient of variation, confidence (fiducial) limits, probability and events, Bayes' theorems , probability theorems, probability distributions, elements of binomial and Poisson distribution, normal distribution curve & properties, kurtosis and skewness, correlation and regression analysis, method of least squares, statistical inference, Student's and paired t-test, F-test and elements of ANOVA, its applications of statistical concept in Pharmaceutical Sciences.

Third Examination for the Degree of Bachelor of Pharmacy

**SCHEME OF PAPERS**

Sr. No.	Subject	Teaching Hrs./Week	Maximum Marks			Minimum Marks for Passing	Time Allowed for Examination Hrs.
			Sessional	Paper	Total		
3-T-1	Manufacturing of Dosage Forms	2	20	80	100	45	3
3-P-1	Manufacturing of Dosage Forms	3	30	70	100	50	4
3-T-2	Medicinal Chemistry -1	2	20	80	100	45	3
3-P-2	Medicinal Chemistry -1	3	30	70	100	50	4
3-T-3	Pharmaceutical Bio- Chemistry	2	20	80	100	45	3
3-P-3	Pharmaceutical Bio- Chemistry	3	30	70	100	50	4
3-T-4	Chemistry of Natural Products	2	20	80	100	45	3
3-T-5	Pharmacognosy –II	2	20	80	100	45	3
3-P-5	Pharmacognosy –II	3	30	70	100	50	4

3-T-6	Pharmacology – I	2	20	80	100	45	3
3-P-6	Pharmacology – I	3	30	70	100	45	4
3-T-7	Hospital And Community Pharmacy	2	20	80	100	45	3
3-P-8	Industrial Visit (Project Report)	-	-	-	50	25	-

### B. Pharm. Third Year

#### 3-T-1 Manufacture of Dosage Forms

1. Powders : Advantages and limitations as dosage forms manufacturing procedures, special care and problems in manufacturing powders, effervescent granules and sals, dusting powders.
2. Liquid Dosages Forms: Introduction, types of additives used in formulations, stabilisers, preservative, suspending agents emulsifying agents, solubilizers, manufacturing packaging and solution of clear liquids, suspensions and emulsions official in pharmacopoeia.
3. Semisolid Dosage Forms: Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semisolids, clear gels manufacturing procedure, evaluation and packaging.
4. Suppositories: Ideal requirements, bases, manufacturing procedure, packaging and evaluation.
5. Capsules: Advantage and disadvantages of capsule dosage form, material for production of types gelatine capsule, sizes of capsule, capsule shell, capsule content, capsule filling machineries and equipment, evaluation of capsule. Importance of base absorption and minimum/gm factors in soft capsules
6. Tablets: Formulation of different types of tablets, granulation technology on large-scale by various techniques, physics of tablets making, different types of tablet compression machinery and the equipment's employed, evaluation of tablets.
7. Blood Products and Plasma Substitutes: Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin, foam plasma substitutes, ideal requirements, PVP, dextran etc. for control of blood pressure as per I.P.
8. Pharmaceutical Aerosols: Definition, propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications.
9. Ophthalmic Preparation: Requirements, formulation, methods of preparation, containers, and evaluation.
10. Cosmetology and Cosmetic Preparations: Fundamentals of cosmetic science, structure and functions of skin and hair. Formulation, preparation and packaging of cosmetics for skin, hair dentifrice and manicure preparations like nail polish, Lipsticks, eyelashes, baby care products and Herbal cosmetics.

#### 3-P-1 Manufacture of Dosage Forms (Practical)

Experiments based on Theory topics.

#### 3-T-2 Medicinal Chemistry-I

1. Introduction and History
2. Biopharmaceutical Properties of Drug Substance
3. Structural features and Pharmacological activity
4. Theoretic aspects of drug design
5. Molecular Modelling
6. Receptors and Drug action
7. Physicochemical Properties in relation to biological action.
8. Metabolic changes of drugs and related organic compounds.
9. The synthesis and SAR of the compound, Classification under each class and Biochemical approaches in drug design wherever possible should be discussed.
  - a. Adrenergic agents: Phenyl ethylamine analogs, Epinephrine, Nor-epinephrine, Ephedrine, Pseudo- ephedrine HCl, Metaraminol bitartrate, Triminoeptane and Naphazoline HCl.
  - b. Cholinergic and anticholinergic: Acetylcholine and its analogs, Atropine
  - c. Neuromuscular Blocking Agents
  - d. General anaesthetics: - Cyclopropane , halothane , vinyl ether , tribromethanol , Sodium . thiental

- e. Local anaesthetics: - Cocaine, Procaine Hydrochloride Benzocaine Butacaine sulphate. Metabutethiamine HCl, Dibucaine HCl, Lignocaine HCl, Dipiperdon HCl.
- f. Hypnotic and Sedatives: - Barbitone sodium. Allobarbitone Hexabarbitone and Glutethimide, Sulfonals.
- g. Tranquilizers: - Reserpine Benzquinamide, Chlopromazine HCl. Triflupromazine HCl, Chlorcyclizine HCl. Chlordizepoxid and Diazepam.
- h. Anticonvulsants: - Phenobarbital. Diphenhydantoin. Trmethadione. paramethadione phenisuximide.
- i. Antidepressant: Imipramine, amitryptaline, Doxepine, Trimipramine, clomipramine, Desipramine, Nortriptyline, Maprotilline, Amoxapine, MAO inhibitors Lithium Compounds
- j. Analgesics, antipyretics and Anti-inflammatory agents: - Morphine HCl, Mefenamic acid, Imdomethacin, Acetaminophen, aminopyrin, Phenybutazone and Ibuprofen, Analgin, pethidine, Dexapropoxyphen, Ketoprofen.
- k. Diuretics: - Mersalyl, Ehcacrynic acid Aminophyline, Aminometradine. Triameterene Acetazolamide and Bendroflumethiazide Chlorthiazide. Chlorthalidone. Furesemide and Spironolactone mercurials, Carbonic anhydrase inhibitors and bezothidiazines
- l. Antihypertensive: - Piperoxan, Dibenamine, Azapentine phosphate. Tolazoline Hydrochloride. Propranolol hydrochloride, Hexa-methonium Bromide. Pentolinium tartrate. dopa-Guanethidine Sulphate. A study of Rauwolfia veratrum and Ergot alkaloids in general
- m. Analeptics: - Picrotoxin, Pentylenetetrazol, Nikethamide, Caffeine, amphetamine and N-allylmorphine.
- n. Expectorants and Antitussive: Potassium glucosulphonate, Terpenehydrate, Noscapine, Carbetapentane citrate.

### 3-P-2 Medicinal Chemistry-I (Practical)

Experiments based on Theory topics.

### 3-T-3 Pharmaceutical Bio-chemistry

- 1. Biochemical organisation of the cell and transport processes across cell membrane.
- 2. The concept of free energy, determination of change in free energy from equilibrium concept and reduction potential, bioenergetics, production of ATP and its biological significance.
- 3. Enzymes: Nomenclature, enzyme kinetics and its mechanism of action, mechanism of inhibition, enzymes and ISO - enzymes in clinical diagnosis.
- 4. Co-enzymes: Vitamins as co-enzymes and their significance, Metals as co-enzymes and their significance
- 5. carbohydrate Metabolism: Conversion of polysaccharide to glucose - 1- phosphate Glycolysis and fermentation and their regulation, Gluconeogenesis and glycogenolysis, Metabolism of galactose and galactosemia, Role of sugar nucleotides in biosynthesis, and Pentosephosphate pathway.
- 6. The Citric Acid Cycle: Significance, reactions and energetic of the cycle, Amphibolic role of the cycle and Glyoxal acid cycle.
- 7. Lipids Metabolism: Oxidation of fatty acids,  $\beta$ -oxidation,  $\alpha$ -oxidation,  $\omega$ -oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids, Control of lipid metabolism, Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes), phospholipids, and sphingolipids.
- 8. Biological Oxidation: Redox-Potential, enzymes and co-enzymes involved in oxidation reduction & its control. The respiratory chain, its role in energy capture and its control, Energetic of oxidative phosphorylation, Inhibitors of respiratory chain and oxidative phosphorylation. Mechanism of oxidative phosphorylation.
- 9. Nitrogen & Sulphur Cycle: Nitrogen fixation, ammonia assimilation, nitrification and nitrate assimilation, Sulphate activation, sulphate reduction. Incorporation of sulphur in organic compounds, Release of sulphur from organic compounds.
- 10. Metabolism of Ammonia and Nitrogen Containing Monomers: Nitrogen balance, Biosynthesis of amino acids, Catabolism of amino acids, Conversion of amino acids to specialised products, Assimilation of ammonia, Urea cycle, metabolic disorders of urea cycle, metabolic disorders of urea cycle, Metabolism of sulphur containing amino acids, Conversion of amino acids Porphyrin biosynthesis, formation of bile pigments, hyperbilirubinemia, Porphyrin biosynthesis, Purine nucleotide Interconversion, Pyrimidine biosynthesis, and formation of deoxyribonucleotides.
- 11. Biosynthesis of Nucleic Acids: Brief introduction of genetic organization of the mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA and its replication, Mutation, Physical & chemical mutagenesis/carcinogenesis, DNA repair mechanism, Biosynthesis of RNA.
- 12. Genetic Code and Protein Synthesis: Genetic code, components of protein synthesis, and Inhibition of protein synthesis, Brief account of genetic engineering and polymerase chain reaction.
- 13. Regulation of gene expression.

### 3-P-3 Pharmaceutical Biochemistry (Practical)

Experiments based on Theory topics

### 3-T-4 Chemistry of Natural Products

1. Chemical and spectral approaches to simple molecules of natural origin.
2. Concept of stereoisomerism taking examples of natural products.
3. Chemistry , biogenesis and pharmacological activity of medicinally important monoterpene , sesquiterpene , diterpene , and triterpenoids .
4. Carotenoids : A carotenoids , B carotene's , vitamin A , Xanthophylls of medicinal importance .
5. Glycosides : Chemistry and biosynthesis of digitoxin , digoxin , hecogenin , sennosides , diogenin and triterpenoids .
6. Alkaloids : Chemistry , biogenesis and pharmacological activity of atropine and related compounds ; quinine , reserpine , morphine , papaverine , ephedrine , ergot and vicia alkaloids .
7. Chemistry and biogenesis of medicinally important lignans and quassinoids , flavonoids .
8. Chemistry and therapeutic activity of penicillin, streptomycin and tetracycline.

### 3-T-5 Pharmacognosy-II

1. Cultivation, collection, processing and storage of crude drugs : Factors influencing cultivation of medicinal plants Types of soils and fertilizers of common use Pest management and natural pest control agents. Plant hormones and their application, Polyploidy mutation and hybridization with reference to medicinal plants.
2. Phytochemical screening: Fundamental principles of phytochemical screening of important active constituents and their isolation of following drugs: Alkaloids, saponins, cardenolides, flavonoids, tannins, glycosides, amino acids in plant extracts.
3. 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:
  - a. Saponins : Liquorice, ginseng, dioscorea, sarsaparilla, and senega,
  - b. Cardioactive sterols: Digitalis, squill, strophanthus and thevetia.
  - c. Anthraquinone cathartics: Aloe, senna, rhubarb and cascara.
  - d. Others : Psoralea, Ammi majus, Ammi visnaga, gentian, saffron, chirata, quassia.
4. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid containing drugs.
  - a. Pyridine - piperidine : Tobacco, and lobelia.
  - b. Tropane : Belladonna, hyoscyamus, datura, and withania
  - c. Quinoline and isoquinoline : Cinchona, ipecaea, opium.
  - d. Indole : Ergot, rauwolfia, catharanthus, nux-vomica and physostigma
  - e. Imidazole : Pilocarpus
  - f. Steroidal : Kurchi
  - g. Alkaloidal amine : Ephedra and colchicum
  - h. Glycoalkaloid : Solanum,
  - i. Purines : Coffee, tea
5. Biological sources, preparation, identification tests and uses of the following enzymes: Diastase, papain, pepsin, trypsin, pancreatin.
6. General techniques of biosynthetic studies and basic metabolic pathways. Brief introduction to biogenesis of secondary metabolites of pharmaceutical importance.
7. Plant bitters and sweeteners

### 3-P-5 Pharmacognosy-II (Practical)

Experiments based on Theory topics

### 3-T-6 Pharmacology - I

1. General Pharmacology
  - Introduction to Pharmacology
  - Mechanism of action
  - Factors Modifying Drug dose and Response,
  - Pharmacodynamics
  - Pharmacokinetics
  - Factors affecting absorption from gut.
  - Bioassay of drug and biological standardization
  - Gene-Based Therapy
2. Classification, Principle of drug action, Receptor, dynamics of absorption, distribution, metabolism, execution, doses and side effect of following classes of drugs.
  - a). Autonomic Nervous system: Parasympathomimetics, Parasympatholytics, sympathomimetics, sympatholytics, neuromuscular blocking, agents and ganglion blocking agents.
  - b). Drugs acting on Central Nervous system: Synaptic transmission in C.N.S., General anaesthetics, Hypnotics and Sedatives, Anti-epileptics, Anti-parkinsonism drugs, Psychopharmacological agents, CNS stimulant, Drug addiction, Management of CNS disorders (Epilepsy, parkinsonism, schizophrenias, depression)
  - c). Analgesics and antipyretics, Anti-inflammatory agents Drugs used in gout. Management of disorders (Rheumatic diseases, gout and hyperuricemia)
  - d). Drugs acting on gastrointestinal system: Purgatives, Ant diarrhoeal drugs, treatment of m).peptic ulcers, Emetics and ant emetics Miscellaneous - Carminatives , Demulcents , protective , adsorbents , digestatns , enzymes and mucolytics.
  - e). Appetite stimulants and suppressants
  - f). Local Anaesthetics
  - g). Drugs acting on respiratory system: Bronchodilators, antitussive, expectorants and respiratory stimulants. Management of disorders (Asthma)
  - h). Drugs acting on cardiovascular system: - Cardiac glycosides, antihypertensive, anti arrhythmic drugs, coronary dialators, antihyperlipidemic drugs and Diuretics. Management of CVS disorders (Hypertension, CCF, Angina, Acute Myocardial Infraction, cardiac Arrhythmias)

### 3-P-6 Pharmacology – I (Practical)

Experiments based on Theory topics

### 3-T-7 Hospital and Community Pharmacy

1. Organization and structure: Organization of hospital and hospital pharmacy, responsibility of a hospital pharmacist, pharmacy and therapeutic committee.
2. Hospital formulary: contents, preparation and revision of hospital formulary.
3. Drug store Management and inventory control: organization of drug store. Types of materials stocked. Storage conditions. Purchase and inventory control: Principles, purchase procedures, purchase order, procurement and stocking
4. Drug distribution system in hospitals: Out-patient dispensing, method adopted. Dispensing of drug tom patients. Types of drug distribution systems. Dispensing of drugs to ambulatory patients. Dispensing of controlled drugs.
5. Introduction to central sterile supply unit.
6. Manufacture of sterile and non sterile products: Policy making of manufacturable items, demands of personal requirements, manufacturing practice. Master formula record, production control, manufacturing records.
7. Drug information services: Sources of information on drugs, disease, treatment schedules, procurement of information, computerized services (e.g. MEDLINE), retrieval of information, medication error.
8. Record and reports: Prescription filling, drug profile, patient medication, cases on drug interaction and adverse reaction, idiosyncratic cases etc.
9. Pharmaceutical care concept and implementation. Role of hospital pharmacists in educational and training programmes.
10. Community Pharmacy: Organization and structure of retail and whole sale drug store of drug store and design, legal requirements for establishment, maintenance and drug store –dispensing of proprietary products. Maintenance of record of retailed and whole sale. Patient counselling, role of pharmacist in community health care and education.

**Fourth Examination for the Degree of Bachelor of Pharmacy**

SCHEME OF PAPERS

Sr. No.	Subject	Teaching Hrs./Week	Maximum Marks			Minimum Marks for Passing	Time Allowed for Examination Hrs.
			Sessional	Paper	Total		
4-T-1	Pharmaceutical Technology	2	20	80	100	45	3
4-P-1	Pharmaceutical Technology	3	30	70	100	50	4
4-T-2	Medicinal Chemistry -II	2	20	80	100	45	3
4-T-3	Drug Analysis-II	2	20	80	100	45	3
4-P-3	Drug Analysis-II	3	30	70	100	50	4
4-T-4	Pharmacognosy –III	2	20	80	100	45	3
4-P-4	Pharmacognosy –III	3	30	70	100	50	4
4-T-5	Pharmacology –II	2	20	80	100	45	3
4-P-5	Pharmacology –II	3	30	70	100	45	4
4-T-6	Bio-Pharmaceutics	2	20	80	100	45	3
4-T-7	Pharmaceutical Biotechnology	2	20	80	100	45	3
4-P-7	Pharmaceutical Biotechnology	3	30	70	100	50	4
3-T-8	Pharmaceutical Microbiology	2	20	80	100	45	3
3-P-8	Pharmaceutical Microbiology	3	30	70	100	50	4
4-T-9	Industrial Management and Accountancy	2	20	80	100	45	3
4-P-10	Project Work	-	-	-	100	50	-

**B. Pharm. Fourth Year**

**4-T-1 Pharmaceutical Technology**

1. Preformulation studies:
  - a) Study of physical properties of drug like physical form, particle size, shape, density, wetting dielectric constant, Solubility, dissolution and organoleptic property and their effect on formulation, stability and bioavailability.
  - b) Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc., and their influence on formulation and stability of products.
  - c) Study of pro-drugs in solving problems related to stability, bioavailability and elegance of formulations
2. Design, development, formulation, evaluation and validation methods for pharmaceutical operations involved in the production of following pharmaceutical products. Capsules, Tablets, Powders, Suppository, Liquid Dosage forms, Solutions, Suspensions, Emulsions, Semisolid Dosage forms, Ointments and Cream.
3. Parental Products.
  - a. Pre-formulation factors,
  - b. Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization & preparation of sterile powders, equipment for large-scale manufacture and evaluation of parenteral products.
  - c. Aseptic Techniques-source of contamination and methods of prevention, Design of aseptic area, Laminar flow bench services and maintenance
  - d. Sterility testing of Pharmaceuticals.
4. Sustained Released Products: Techniques with reference to micro-encapsulation and coating techniques ( Sugar, film, enteric coating ), evaluations of SR dosage forms. With special reference to microcapsules, Nano-particals, liposome, resealed erythrocytes, Trans dermal drug delivery system and occusers.
5. Introduction to Novel Drug Delivery System.
6. Performance evaluation methods
  - a) In vitro dissolution studies for solid dosage forms methods, interpretation of dissolution data.
  - b) Bioavailability studies and bioavailability testing protocol and procedures.
  - c) In vivo methods of evaluation and statistical treatment.
7. GMP and quality assurance, Quality audit.

**4-T-1 Pharmaceutical Technology (Practical)**

Experiments based on Theory topics

**4-T-2 Medicinal Chemistry-II**

The synthesis and SAR of the compound, Classification under each class and Biochemical approaches in drug design wherever possible should be discussed.

1. Sex-hormones: - Synthesis of testosterone, progesterone & oestrone from diosgenin & cholesterol. Preparation & use of non steroidal estrogens diethylstilbestrol, Monomesterol, Hexostoerol, Ethinyl estradiol, Ethisterone, Testosterone, Propionate and methyl Testosterone.
2. Cortex Hormones :- Synthesis of cortisone acetate from diosgenin , cholesterol preparation & uses of Dexamethasone acetate, Hydro – cortisone acetate, prednisolone & prednisone , Dexamethasone , Betamethasone , structure action relationship of cortex hormones .
3. Non-Steroidal hormones: - Insulin, Adrenaline & Thyroxin.
4. Antihistaminic:-Ethanolamine derivatives- Diphenhydramine HCl , Dymenhydrinate . Pyrulaminemalate . Pheniramine maleate. Chlorpheniramine maleate Promethazine HCl.
5. Anticoagulants: Bishydroxy coumarin, Ethyl biscoumacetate, Sodium warfarin , Diphenadione, and Heparin.
6. Vitamins :- Constitution & physiological importance , Vitamin A, Thiamine , Riboflavin , ascorbic acid , Folic acid , Pantothenic acid & pyridoxin.
7. Antineoplastic drugs:
8. Antibiotic :- Chemistry, Biosynthesis and semi-synthetic penicillin, Chloramphenicol & tetracycline , A study of the properties and use of Ampicillin, Kanamycin , Neomycin, Erythromycin, streptomycin, Nystatin, Bacitracin and Cycloserine. Structural variations in chloramphenicol and Tetracycline.
9. Sulfonamides: - Mechanism of action of Sulfonamides synthesis and uses of Sulphacetamide. Sulphaguandine, Sulphadiazine, Sulphamerazine, Sulphasomidine, Trimethoprim, Phathiazole, Sulphadoxin.
10. Anti-malarial:- Structure activity relationship in 4-amino-quinolines and 8- amino-quinolines. Synthesis and uses of Chloroquine , Amodiaquine, pamaquine, primaquine, Quinacrine , proguanil and pyrimethamine.

11. Anti-amoebics: - Factors affecting the efficiency of antiamebic drugs, Drug combination. A study of Emetine, conesine-9-quinolinal and antibiotics as antiamebics, synthesis and uses of Bially-lunical , Mantomide and Dihydroxy quinoline, Metronidazole, Tinidazole.
12. Antiviral including anti HIV agents:
13. Medicinal Dyes :- Synthesis & uses of Gentian violet, Malachite green, Brilliant green, amaranth, Resochin brown, 9-aminoacridine, Acriflavin and methylene blue. Diloxinate furoate.
14. Anthelmintics: - A study of santonin, Ascaridol, Filicid Antimalarial & antibiotics & anthelminitics. Synthesis of Diethyl carbamazine, Mebandazole, Piperazine citrate Tetramisole, Levamisole
15. Antifungal Agents: - General survey.
16. Antitubercular drugs: - A study of P.A.S. Isonicotinaldehyde, thiosemicarbazine, Isoniazid & streptomycin. pyrazinamide , Ethambutol, Rifampicin, Ethionamide.
17. Antidiabetic agents:- Insulin, Carbutamide, Chloropamide. Tolbutamide
18. Plasma Extenders: General Survey of important compounds.
19. Diagnostic agents: General survey of important compounds
20. Immunosuppressive and immunostimulants:

#### 4-T-3 Drug Analysis –II

1. Introduction, pharmacopoeial monograph, literature collection, data handling and expression of analytical results - Documentation and record keeping.
2. Validation: Validation of analytical Methods and Equipment as defined in USP
3. General physical method- Density, Solubility, Molecular weight, Refractometry, Optical activity, Viscosity, Surface tension.
4. Analysis of Drugs and Excipients in Solid State- Introduction - particle size analysis and scope of methods.
5. Instrumental methods in the development and use of medicines -Introduction, product characterisation for drug development, product development, production and pharmacopial controls, drug metabolism and pharmacokinetics.
6. Electrochemical methods-Introduction, conductmetric titration, potentiometry, voltametry and coulometry, electrochemical detection in HPLC.
7. The basis of spectrophotometry- Introduction, atomic spectra, molecular spectra, instrumentation, spectrophotometer.
8. Ultraviolet-visible absorption spectrophotometry- Introduction, quantitative spectrophotometric assay of medicinal substances, assay of substances in multi-component samples, optimum condition for spectrophotometric measurements, structural analysis, experiments in ultraviolet- visible sptrophotometriy.
9. Atomic emission spectrometry and atomic absorption spectrophotometry- Atomic emission sptrometry, atomic absorption sptrophotometry.
10. Sptroflurimetry- Introduction, instrumentation, application and quantitative aspects.
11. Radiochemistry - Radio-immuno assay (RIA) and related immuno assay techniques. ELISA -technique - theory, Instrumentation and applications.
12. Nuclear Magnetic resonance spectroscopy- Introduction, instrumentation, application and quantitative aspects, carbon-13 NMR (CMR) spectroscopy.
13. Mass spectrometry- Introduction, instrumentation and practical application.
14. The application of spectroscopic techniques to structural elucidation- Introduction aids to sprtal interpretation, exercise and solutions.
15. Chromatography- Introduction and Classification of chromatography, paper chromatography, thin layer chromatography (TLC), High performance thin layer chromatography (HPTLC), Gas chromatography (GC), High performance liquid chromatography (HPLC), and their pharmaceutical applications.  
Development of chromatogram
  - a. Paper chromatography- Introduction, ascending chromatography, descending chromatography, two-dimensional chromatography, applications.
  - b. Thin layer chromatography- Introduction, quantitative measurements, photo-documentation, applications, identification of compounds, impurities.
  - c. Gas chromatography- Introduction, instrumentation and application.
  - d. HPLC - Introduction, instrumentation and application
  - e. HPTLC- Introduction, instrumentation, application.
  - f. Ion exchange chromatography - Ion exchange resins Applications.
  - g. Gel permeation chromatography - Introduction, Apparatus and technique, applications.

#### 4-P-3 Drug Analysis -II (Practical)

Experiments based on Theory topics

#### 4-T-4 Pharmacognosy-III

1. Role of medicinal and aromatic plants in national economy.
2. Introduction , classification and study of different chromatographic methods and their applications in evaluation of herbal drugs.
3. Modern medicinal plants and derived products with special reference to diosgenin (dioscorea), taxol (Taxus sps) digitalis.
4. Studies of traditional drugs, Common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulations of following indigenous drugs: Amla, Kantkari, Satavari, Tylophora, Bhilawa, Kalijiri, Batch, Rasna, , Chitrack, Apamarg, Gokhru, Shankhapushp, Brahmi, Adusa, Arjuna, Ashoka, Methi, Lahsun, Palash, Guggal, Gyunema, Shilajit, Nagarmoths and Neem.
5. Nutritional requirements, growth and their maintenance, Applications of plant tissue culture in Pharmacognosy
6. An Indian poisonous plants, natural allergens and tennial toxins
7. Herbs as health foods
8. Marine Pharmacognosy: Novel medicinal agents form marine source.

#### **4-P-4 Pharmacognosy-III (Practical)**

Experiments based on Theory topics

#### **4-T-5 Pharmacology – II**

Classification, Principle of drug action, Receptor, dynamics of absorption, distribution, metabolism, execution, doses and side effect of following classes of drugs.

1. Drugs used in the therapy of shock.
2. Drugs Acting on the Hemopoietic System: Hematinics, Anticoagulants, Vitamin K and hemostatic agents. Fibrinolytic and anti-platelet drugs. Blood and plasma volume expanders. Management of disorders: - Anemias.
3. Autacoids: Histamine, 5- HT and their antagonists. Prostaglandins, thromboxanes and leukotrienes. Pentagastrin , Cholecystokinin , Angiotensin , Bradykinin and Substance P.
4. Pharmacology of Endocrine System: Hypothalamic and pituitary hormones. Thyroid hormones and anti - thyroid drugs, parathormone , calcitonin and Vitamin D . Insulin, oral hypoglycaemic agents glucagons. Management of disorders:- Diabetes mellitus and thyroid disorders.
5. Steroids: ACTH and corticosteroids. Androgens and anabolic steroids. Estrogens, progesterone and oral contraceptive. Drugs acting on the uterus.
6. Chemotherapy: General Principles of Chemotherapy.
  - a. Sulphonamides and cotrimoxazole.
  - b. Antibiotics - Penicillines, Cephalosporines, Chloramphenicol, Erythromycin, Quinolones and miscellaneous Antibiotics.
  - c. Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, unitary tract infections and sexually transmitted diseases.
  - d. Chemotherapy of malignancy and Immunosuppressive Agents.
  - e. Management of disorders: Tuberculosis, UT Infection, Enteric infections, Upper respiratory infection, acute leukaemia and Hodgkin's diseases.
7. Principles of Toxicology: Definition of poison, general principles of treatments of poisoning with particular reference to barbiturates, opiates, organo-phosphorous and atropine poisoning. Heavy metals and heavy metal antagonists.
8. Basic Concepts of pharmacotherapy: Clinical pharmacokinetics and individualisation of Drug therapy. Drug Delivery System and their Biopharmaceutical & therapeutic Considerations. Drug use During Infancy and in the Elderly (Paediatrics & Geriatrics). Drug use during Pregnancy. Drug induced Diseases. The Basics of Drug Interactions. General principles of Clinical Toxicology. Interpretation of Clinical Laboratory Tests.
9. Therapeutic Drug Monitoring.
10. Concept of Essential Drug and Rational Drug Use.

#### **4-P-5 Pharmacology – I (Practical)**

Experiments based on Theory topics

#### **4-T-6 Bio-pharmaceutics**

1. Introduction to bio- pharmaceutics and pharmacokinetics and their role in formulation development.

2. Bio-pharmaceutics: Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis), Factors influencing absorption – Physicochemical, pH partitioning theory physiological and pharmaceutical. Drug distribution in the body, plasma protein binding.
3. Pharmacokinetics: Significance of plasma drug concentration measurements. Compartment model-Definition and Scope. Pharmacokinetics of drug absorption-Zero order and first order absorption rate constant using Wagner-Nelson and Loo-Reigelman method. Volume of distribution and distribution coefficient. Compartment kinetics – One compartment and two compartment models. Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intravascular and oral route. Clearance concept, Mechanism of renal clearance, clearance ratio, determination of renal clearance. Extraction ratio, hepatic clearance, biliary excretion, Extra hepatic circulation. Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis-Menten Equation, detection of non-linearity (saturation mechanism).
4. Clinical Pharmacokinetics: Definition and scope Dosage adjustment in patients with and without renal and hepatic failure. Design of single dose bio-equivalence study. Pharmacokinetic drug interactions and their significance in combination therapy.
5. Bioavailability and bio-equivalence: Measures of bioavailability.  $C_{max}$ ,  $t_{max}$ , and area under the curve (AUC), Design of single dose bioequivalence study.
6. Software used in bio-pharmaceutics and its importance.

#### 4-T-7 Pharmaceutical Biotechnology

1. Immunology and Immunological Preparations: Principles, antigens and haptens, immune system, cellular humoral immunity, immunological tolerance, antigen-antibody reactions and their applications, Hypersensitivity, Active and passive immunization; Vaccines-their preparation, standardization and storage.
2. Genetic Recombination: Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications, Development of hybridoma for monoclonal antibodies. Study of drugs produced by biotechnology such as Actives, Humulin, Humatrope, HB etc.
3. Antibiotics: Historical development of antibiotics, Antimicrobial spectrum and methods used for their standardization, Screening of soil for organisms producing antibiotics, fermented, its design, control of different parameters, Isolation of mutants, factors influencing rate of mutation. Design of fermentation process. Isolation of fermentation products with special reference to penicillin's, streptomycin's tetracycline's and vitamin B12.
4. Microbial Transformation: Introduction, types of reactions mediated by micro organisms, design of biotransformation process, selection of organisms, biotransformation process and its improvements with special reference to steroids.
5. Enzyme immobilization: Techniques of immobilization of enzymes, factors affecting enzyme kinetics, Study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptodornase, amylases and protease etc. Immobilization of bacteria and plant cells.

#### 4-P-7 Pharmaceutical Biotechnology (Practical)

Experiments based on Theory topics

#### 4-T-8 Pharmaceutical Microbiology

1. Scope of Microbiology - Historical development - applications to pharmaceuticals
2. Classification of micro-organisms into bacteria, yeast and fungi, rickettsia and viruses.
3. Biology of micro-organisms :
  - a). Bacteria - Size and shape, structure, cell wall, cytoplasm, capsules, spores (properties, formation, germination), locomotion, reproduction (binary fission, reproduction involving genetic exchange (transformation, conjugation and transaction), growth, growth requirements, culture media, growth curve, measurement of bacterial growth and mean generation time, counting methods (total count and viable count) - characteristics of disease causing bacteria (Staphylococcus, Streptococcus, Diplococcus, Neisseria, Clostridium, Corynebacterium, Pseudomonas, Vibrio, Pasteurella, Hemophilus, Escherichia, Salmonella, Shigella, Proteus, Klebsiella, Helicobacter, Campylobacter, Mycobacterium, Treponema, Leptospira).
  - b). Yeasts and Fungi - Introduction, characteristics of *Saccharomyces cerevisiae* and *Candida albicans*, clinical significance - Penicillium and Aspergillus, applications and clinical significance - Epidermophyton, Microsporium and Trichophyton, clinical significance..
  - c). Rickettsia - Introduction - clinical significance and applications.
  - d). Viruses - Introduction - general properties (size, nucleic acid content, metabolism) - structure of viruses (helical symmetry and icosahedral symmetry) - effect of chemical and physical agents on viruses - virus-host

cell interactions - bacteriophage and its epidemiological uses (lytic growth cycle and lysogeny) - human viruses and their cultivation in cell culture, chick embryo and animal inoculation - multiplication of human viruses - interferon's - HIV - tumor viruses - prions.

4. Sterilization, Disinfection, Sanitation and Infection control:  
Sterilisation - Definition - Classification into thermal and non-thermal methods - details of hot air sterilization, autoclaving, gaseous, radiation, sterile filtration (method of packaging and equipment to be used should also be covered) - bio burden determination - sterilisation monitors (physical, chemical and biological indicators) - sensitivity of micro organisms, survivor curves, expression of resistance (D-values and z-valued), sterility assurance - Applications of autoclaving in hospitals (sterilization of dressings, gauzes for wet dressing, recontaminations of sterilized goods, rubber gloves, catheters drains and tubes, surgical instruments, syringes and needles-water sterilization for hospital and pharmaceutical industry supply).
5. Disinfection and Sanitation - Definition (antiseptics, preservatives and sanitising agents) - Chemical classification (acids and esters, alcohols etc.) - factors affecting choice of antimicrobial agent (properties of chemical agent and microbiological challenge, environmental factors and toxicity of agent) - factors affecting disinfection process - evaluation of disinfection (RW coefficient, Kelsey-Sykes test) - dynamics of disinfection.
6. Microbial Epidemiology - portal of entry (respiratory tract, intestinal tract, urogenital tract, skin and conjunctiva) - resistance to host defence, inflammatory response, avoidance of phagocytosis - manifestation of disease - damage to tissues.
7. Industrial Microbiology: Preparation, Standardization of Various antibiotics, vitamins and glycerides.

**4-P-8 Pharmaceutical Microbiology (Practical)**  
Experiments based on Theory topics

**4-T-9 Industrial Management and Accountancy**

1. Concept of Management: Administrative Management (Planning, organizing, Staffing, Directing and controlling), Entrepreneurship development, operative management (Personnel, Materials, Production, Financial Marketing, Time/space, Margin/Morale), Principles of Management (Co-ordination, Communication, Motivation, Decision making, leadership, Innovation, Creativity, Delegation of Authority/Responsibility, Record Keeping), Identification of key points to give maximum thrust for development and perfection.
2. Accountancy: Principles of Accountancy, Ledger posting and book entries, preparation of trial balance, columns of cash book, Bank reconciliation statement, rectification of errors, Profits and loss account, balance sheet, purchase keeping and pricing of stocks, treatment of cheques, bills of exchange promissory notes and hundies, documentary bills.
3. Economics: Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, labour welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods.
4. Pharmaceutical Marketing: Functions, buying, selling, transportation, storage, finance, feedback, information, channels of distribution, wholesale, retail, departmental store, multiple shop and mail order business.
5. Salesmanship: Principles of sales promotion, advertising, ethics of sales, merchandising, literature, detailing Recruitment, training, evaluation, compensation to the pharmacist.
6. Market Research: Measuring & Forecasting Market demands-Major concept in demand measurement, Estimating current demand, Geodemographic analysis, Estimating industry sales, market share & future demand. Market segmentation & Market Targeting.
7. Materials Management: A brief exposure or basic principles of materials management major areas, scope, purchase, stores, inventory control and evaluation of materials management.
8. Production Management: A brief exposure of the different aspects of Production Management-Visible and Invisible inputs, Methodology of Activities Performance Evaluation Technique, Process-Flow, Process Know-how maintenance management.
9. Financial Management: Budget and its types: financial budget, expenditure budget, performance budgeting