

## B. Pharm 1<sup>st</sup> year Syllabus

### DEPARTMENT OF PHARMACEUTICAL SCIENCES, GJUS&T, HISAR SYLLABUS FOR BACHELOR OF PHARMACY

#### I Year B.Pharm

##### Semester- I

##### **BPL 111 PHARMACEUTICAL CHEMISTRY – I (Pharmaceutical Organic Chemistry)**

*7 credits (4-2-4)*

Structure and Properties:  
Atomic structure: atomic orbitals, molecular orbital theory. Wave equation, molecular orbital, bonding and anti-bonding orbitals, electronic configuration of some molecules, covalent bonds, hybrid orbitals, intermolecular forces, bond dissociation energy, polarity of bonds, polarity of molecules, structural and physical properties intermolecular forces, acids and base, isomerism. Stereochemistry:

introduction, optical activity, stereoisomerism, and specification of configuration, reactions involving stereoisomers. Structure, Nomenclature, preparation and reactions of alkanes, alkenes, alkynes, cycloalkanes, dienes, benzene, polynuclear aromatic compounds, arenes, alkyl halides, alcohols, ether epoxides, amines, phenols, aldehydes and ketones, carboxylic acids, functional derivatives of carboxylic acid, carbanions, aldol

condensation, claisen condensation, malonic esters and acetoacetic ester synthesis. Alpha, beta unsaturated carbonyl compounds. Electrocyclic reactions, sigmatropic reactions, neighboring group effects. Catalysis by transition metal complexes, Stereoselective and Stereospecific reactions.

**PRACTICALS:** Synthesis of selected organic compounds. Identification of organic compounds and their derivatisations. Introduction to the use of stereomodels.

##### **BPL 112 PHARMACEUTICAL CHEMISTRY – II**

(Pharmaceutical Inorganic Chemistry)

*7.0 credits (4-2-4)*

An outline of the methods of preparation, properties, uses, sources of impurities, tests for purity and identity, including the limit tests for iron, arsenic, lead, heavy metals, chloride, sulphate and special tests if any, of the following classes of inorganic Pharmaceuticals included in Indian Pharmacopoeia monograph details. Acids and bases: Buffers, water,

Gastrointestinal agents: acidifying agents, antacids, protectives and adsorbent, Cathartics. Major extra and intra-cellular electrolytes: Physiological ions, electrolytes used for replacement therapy, acid base balance and combination therapy. Essential and trace elements: transition elements and their compounds of pharmaceutical importance: Iron and haematinics, mineral supplements. Cationic and anionic compounds of inorganic drugs useful for systemic effects. Topical agents: protectives, astringents and anti-infectives. Gases and vapours: oxygen, anesthetics and respiratory stimulants. Dental products: dentrifices, anti-carries agent. Complexing and chelating agents used in therapy. Miscellaneous agents: sclerosing agents, expectorants, emetics, poisons and antidotes sedatives etc. Pharmaceutical aids used in Pharmaceutical industry Antioxidants, preservatives, filter aids, adsorbents, diluents, excipients, suspending agents, colorants etc.

Inorganic  
Radiopharmaceuticals  
nuclear  
Radiopharmaceutical,  
reactions, nomenclature,  
methods of obtaining their  
standards and units of  
activity, measurement of  
activity, clinical  
applications and dosage,  
hazards and precautions.

**PRACTICALS:** The  
background and systemic  
qualitative analysis of  
inorganic mixtures up to 4  
radicals. Six mixtures to be  
analyzed, preferably by  
semi-micro methods. All  
identification tests for  
pharmaceutical, inorganic  
pharmaceutical and  
qualitative tests for cations  
and anions as included in  
the appendix of IP should  
be carried out.

**BPL 113**  
**PHARMACEUTICS – I**  
**(Dispensing and Hospital  
Pharmacy)**

*7 credits (4-2-4)*

Definitions and General  
Dispensing Procedures.

Sources of information  
required for Pharmacists.  
Types of Dispensed  
products Containers,  
closures and labeling for  
dispensed products.  
Sources of error and care  
required in dispensing  
prescriptions. Principles  
involved and procedures  
adopted in dispensing of  
typical preparations like  
mixtures, solutions,  
emulsion, creams,  
ointments, powders,  
pastes, jellies,  
suppositories,  
ophthalmics, pastillers,  
lozenges, pills, lotions,  
liniments, inhalations,  
paints, sprays etc.

Incompatibilities - physical  
and chemical, occurrence  
and methods adopted in  
corrections. Colours  
flavours, sweeteners and  
other additives used in  
prescriptions. Latin terms  
used in prescriptions and  
their English equivalents.  
Pharmaceutical  
Calculations - calculation  
of doses, enlarging and

reducing receipes,  
percentage solutions,  
alligation, alcohol dilutions,  
proof spirit, isotonic  
solutions, displacement  
value etc. Hospital and its  
organization. Pharmacy,  
organization and  
personnel. Hospital  
formulary. Purchasing and  
inventory control, Drug  
distribution, Dispensing to  
inpatients, Dispensing to  
outpatient, Dispensing of  
controlled drugs, Drug  
charges, Prepackaging,  
Central sterile supply, Drug  
information centre,  
Maintenance of records,  
Safe use of medicines,  
Professional practices  
**PRACTICAL** Number of  
practicals based on  
aforementioned theory  
portion but including  
dispensing of preparations  
like emulsions,  
suspensions, solutions,  
creams, ointments,  
inhalations, liniments,  
paints, syrups, mixtures,  
pastes etc.

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## BPL 114 REMEDIAL BIOLOGY

4 Credits (3-0-2)

Methods of classification of plants. Plant cell : its structure and non-living inclusions. Mitosis and meiosis, different types of plant tissues and their functions. Morphology and histology of root, stem, bark, leaf, flower, fruit and seed. Modification of root and stem. General survey of animal kingdom. Structure and life history of parasites as illustrated by amoeba, plasmodium, taenia, ascaris. General structure and life history of insects like mosquito.

**PRACTICALS:** Morphology of plants parts indicated in theory. Care, use and type of microscope. Gross identification of slides of structure and life cycle of lower plants/animal mentioned in theory. Morphology of plant parts indicated in theory. Preparation, microscopic examination of stem. Root and leaf of monocot and dicot leaf. Structure of human parasite and insects mentioned in theory with the help of specimens.

## BPL 114 REMEDIAL MATHS

4 Credits (4-0-0)

Algebra : revision on equation reducible to quadratics and simultaneous equations (linear and quadratic) up to two variable only. Determinants and their six important properties, solutions of simultaneous equations by Cramer's rule. Matrices: Definition of special matrices (like unit, singular, diagonal matrices etc.) arithmetic operation on matrices, transpose, adjoint reciprocal and inverse of a matrix, solution of simultaneous equations using matrices. Partial fractions and resolution of linear and quadratic (non-repeated) partial functions. Evaluation of  $E_n$ ,  $E_n^2$  and  $E_n^3$  Trigonometry: revision on angle measurement and T-ratios addition, subtraction and transformation formulae. T-ratio of multiple, sub multiple and allied angles, solution of simple trigonometric identities based on above concepts. Pharmaceutical application of logarithms. Analytical plane geometry: Cartesian co-ordinates, distance between two points, area of triangle, locus of a point, straight line, slope and intercept form, general equation of first degree.

## Semester II

### BPL 121 PHARMACOGNOSY – I

7 credits (4-2-4)

Definition, history, scope and development of Pharmacognosy. Sources of drugs: biological, marine, geographical and plant tissue cultures as sources of drugs. Classification of drugs: alphabetical, morphological, taxonomical, pharmacological, chemical and others with their merits and demerits. Plant taxonomy: study of the following families with special reference to medicinally important plants- Apocyanaceae. Solonaceae. Rutaceae. Umbelliferae, Leguminosae, 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. Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation. An introduction to active constituents of drugs: their isolation, classification and properties. Systematic pharmacognostic study of the following: Carbohydrates and derived products: Agar, Gum acacia, Isabgol, Pectin, Starch and Tragacanth. Lipids: Bees wax, castor oil, Cocoa butter, Cod-liver oil, Linseed oil, Rice bran oil, Shark liver oil and wool fat. Study of drugs containing resins and resin combinations: Colophony, Podophyllum, Myrrh, Asafoetida, balsam of tolu, Balsam of peru, Benzoin, Turmeric, Ginger. Volatile oils : General methods of obtaining volatile oils from plants, study of volatile oils of Mentha, Coriander, Cinnamon, Orange peel, Lemon grass, Citronella, Cumin, Dill, Clove, Fennel, Eucalyptus, Cardamom, Musk, Sandal Wood. Study of Pharmaceutical aids like talc, diatomite, kaolin, bentonite and gelatin.

### PRACTICALS

Number of practicals based on aforementioned theory portion and including the following: Morphological characteristic of plant families mentioned in the theory. Microscopic measurement of cells and cell contents: starch grains, calcium oxalate crystals and phloem fibres. Determination

of leaf constant such as stomatal index, stomatal number, vein-islet number, vein termination number and palisade ratio. Identification of crude drug mentioned in theory.

### **BPL 122 PHARMACEUTICS – II (General Pharmacy)**

*7 credits (4-2-4)*

Extraction: Various methods of extraction of crude drugs namely percolation (various types including processes for concentrated preparations, constant hot percolation), maceration (various types including processes for organized and unorganized drugs, for concentrated preparations, double and triple maceration processes), Decoction. Liquid Preparations: Formulation, preparation and uses of various liquid products namely syrups, aromatic waters, spirits, solutions, mucilages, elixirs, glycerins, mouthwashes, gargles, nasal drops, ear drops. Immunology : General introduction, infection, factors influencing infection, kinds of immunity, vaccines, (i.e. Tetanus vaccine, Diphtheria vaccine, BCG vaccine, small pox vaccine), virus immunity, toxoids, toxins, diagnostic preparation, sera, antitoxins (i.e. Diphtheria antitoxins, Botulinium antitoxins), brief control of immunological products-identification tests, toxicity tests, sterility tests, potency tests and storage of immunological products. Glandular Product: Introduction, extraction methods and preparation of thyroid, liver, pancreas and pituitary gland. Blood and related products : Whole human blood, concentrated human RBC, dried human plasma, dried human serum, human plasma protein fraction, human fibrinogen, human thrombin, plasma substitute properties, products i.e. PVP, Dextran, absorbable gelatin, sponge, oxidized cellulose, calcium gluconate. Surgical dressings: like fibers, fabrics, bandages, surgical ligatures and sutures i.e. catgut and other absorbable and non-absorbable products. Semisolid dosage forms (ointment and suppositories) ointment, ointment bases, factors governing selection of ideal base, preparation of ointments, Suppositories-suppositories bases, selection of ideal base, production and quality control of suppositories.

**PRACTICALS:** Number of practicals based on aforementioned theory portion and including preparation of the following : Peppermint water, cinnamon water, camphor water, chloroform water, concentrated peppermint water, concentrated cinnamon water, simple syrup, syrup of ginger, syrup of orange, syrup of tolu, compound syrup of ferrous sulphate, spirit of peppermint, spirit of chloroform, spirit of ether, strong solution of ammonium acetate, surgical solution of chlorinated soda, solution of cresol with soap, solution of ferric chloride, strong solution of iodine, solution of hydrogen peroxide tannic acid glycerin, boric acid glycerin mouth washes, nasal drops, ear drops, elixirs mucilage of acacia, mucilage of tragacanth, tincture of orange, capsicum tincture, strong tincture of ginger, tincture of lemon, tincture of tolu, tincture of nuxvomica, liquid extract of liquorice, liquid extract of ipecacuanha, liquid extract of belladonna, liquid extract of senna, concentrated infusion of clove, concentrated infusion of quassia, concentrated infusion of senna, liver extract.

### **BPL 123 PHARMACOLOGY – I (Anatomy, Physiology and Health Education)**

*7 credits (4-2-4)*

Scope of anatomy and physiology with emphasis on relevant basic terminology. Elementary tissues of the human body: Epithelial, connective, muscular and nervous tissues. Osseous system: Types of joints. Skeletal muscles: Anatomy, physiology of muscle contraction. Haemopoietic system: Composition and functions of blood, blood groups and their significance, mechanism of coagulation. Basic anatomy and physiology of lymphatic system and spleen. Physiology of heart: Cardiac cycle, heart sounds and electrocardiogram (ECG); Blood pressure and its regulatory mechanisms. Structure and functions of its different parts including liver, pancreas and gall bladder. Digestion and absorption of food Basic anatomy and physiology of eye, ear. Respiratory System: Anatomy of respiratory organs, Mechanism and regulation of respiration, lung volumes and capacities. Functions of different parts of brain, reflex action, electroencephalogram (EEG). Autonomic Nervous System (ANS): Functions of the autonomic nervous system. Urinary System: Various parts, Physiology of urine formation Male and female reproductive systems. Basic anatomy & physiology of Pituitary gland, Thyroid, Adrenals, Pancreas

their hormones & functions. Health Education: Concepts of health education, hygiene and prevention of disease. Family planning: Various modes of contraception Communicable diseases: Causative agents, modes of transmission and prevention viz. chicken pox, cholera, measles. Acquired - immunodeficiency syndrome (AIDS).

**PRACTICALS:** Study of human skeleton. Study of different systems with the help of charts and models. Microscopic study of different tissues. Estimation of hemoglobin in blood. Determination of bleeding time, clotting time, R.B.C. Count, T.L.C., D.L.C. and E.S.R. Recording of body temperature, blood pressure. Simple experiments involved in the analysis of normal and abnormal urine: Collection of specimen, appearance, determination of Sugars, proteins, bile salts.

## **BPL 124 - PHARMACEUTICAL MATHEMATICS**

*4 credits (4 – 0 – 0)*

Calculus : Differential : Limits and functions, differential coefficient, differentiation of standard functions, including function of a function (chain rule), differentiation of implicit functions, logarithmic differentiation, parametric differentiation, elements of successive differentiation. Integral : integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, by partial fractions and by substitution, formal evaluation of definite integrals. Differential equations : definition and formation of ordinary differential equations, equations of first order and first degree, variable separable, homogeneous equations, linear equations (Liebnitz form) and differential equations reducible to these types. Linear differential equations of order greater than one with constant coefficients, complementary function and particular integrals of  $e^x$ ,  $x^m$ ,  $\sin(ax + b)$  or  $\cos(ax + b)$  types of functions, solution of simple simultaneous linear differential equations, Pharmaceutical transforms. Laplace transforms : definition, properties of linearity and shifting, transforms of elementary function (without proof) and inverse laplace transforms not involving Euler's theorem, transforms of derivatives, solutions of ordinary and simultaneous differential equations. Pharmaceutical statistics : concept, mathematical computations (wherever applicable) and pharmaceutical applications (wherever possible) on : Significant digits and rounding of numbers, collection of primary and secondary data through experiments of surveys sampling and complete enumeration survey, merits and limitations of various random and non-random sampling methods, data organization including frequency distributions and tabulation, diagrammatic representation of data, simple, multiple, sub-divided and floating bar diagrams, pie diagrams, 2-D and 3-D pictographic representation, graphs of frequency distributions. Measures of central tendency, ideal characteristics, mean, median, mode, GM, HM and weighted arithmetic mean from discrete and continuous frequency distribution, quartiles, deciles and percentiles, measures of dispersion, range, quartile deviation, mean deviation, standard deviation, calculation of standard deviation from discrete and continuous frequency distributions, standard error of means, coefficient of variation. Probability and events, Bayes theorem, probability theorems, probability distributions, elements of binomial and Poisson distributions, normal distribution, normal distribution curve and properties, calculation of areas under normal curve and standard normal curve (Z statistic), confidence limits, deviations from normality, Kurtosis and skewness, elements of central limit theorem. Linear correlation and regression analysis, scatter plots, method of least squares, Pearsonian coefficients of correlation and determination, definitions, of amount of explained variance, standard error of estimate and significance of regression (F). Statistical inference, type I and II errors, t-test (paired and unpaired).

## **ENVIORNMENTAL STUDIES:**

Multidisciplinary nature of environmental studies: Definition, scope and importance. Natural resources- Renewable and nonrenewable resources: Natural resources and associated problems- Forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using

mineral resources, case studies. Food resources: World food problems, Changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers, energy flow in the ecosystem. Ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation: Introduction- Definition, genetic, species and ecosystem diversity. Biogeological classification of India, value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values. Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental pollution: Definition, causes, effects and control measures of – air, water, soil, marine, noise and thermal pollution and nuclear hazards. Solid waste management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone, and landslides. Social issues and the environment: from unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people; its problems and concerns, case studies. Environmental ethics: issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case-studies. Wasteland reclamation, consumerism and waste products, environment protection act, Air (Prevention and control of pollution) act, Water (Prevention and control of pollution) act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation, Public awareness. Human population and the environment: Population growth, variation among nations, population explosion – Family Welfare programme. Environment and human health, Human rights, value education, HIV/AIDS, women and child welfare, role of information technology in environment and human health, case studies. Field work: Visit to local area to document environmental assets- river/forest/grassland/hill/mountain. Visit to a local pollute site- Urban/rural/industrial/agricultural. Study of common plants, insects, birds, Study of simple ecosystems- pond, river, hill slopes etc. (Filed work equal to 5 lecture hours)

## **B. Pharm. IInd year syllabus**

### **Semester - III**

#### **BPL 231 PHARMACEUTICS-III (Pharmaceutical Engineering-I)**

*5 Credits (4 -2- 0)*

Flow of fluids: Introduction, mechanism of fluid flow, Reynolds number and its significance, Bernoulli's theorem, manometers and friction losses in pipes, measurement of flow rate using direct weighing or measuring, hydrodynamic methods, displacement meters and dilution methods. Regulation of flow using plug cocks, globe valves, gate valves, unidirectional valves, automatic regulating valve, butterfly valve and diaphragm valve, and water hammer Heat Transfer: Modes of heat transfer, Fourier's law, overall heat transfer coefficient, Stefan-Boltzman's law, single pass heater, multi-pass heater, liquid-liquid heat interchanger and finned tubes Evaporation: Factors affecting evaporation, natural circulation evaporators e.g. evaporating pan, evaporating still, horizontal and vertical tube evaporators, forced circulation evaporators, film evaporators, multiple effect evaporation, material and energy balance of evaporators. Drying: Theory, behavior of solids during drying, static bed dryers, moving bed dryers, fluidized bed dryer and pneumatic bed dryers. Centrifugation: theory, industrial centrifugal filters and industrial centrifugal sedimenters. Filtration: Theory, filter aids, filter media, industrial filters i.e. sand filter, washing and non-washing type filter presses, rotary drum filter, leaf filters, edge filter. Humidification, dehumidification and air conditioning: Principles of Humidification, dehumidification and air conditioning, psychrometry, humidity measurement, large scale equipment for humidification and dehumidification, cooling towers. Refrigeration: Principle and equipment employed for vapor compression refrigeration, lithium bromide absorption refrigeration and steam jet refrigeration. Applications of refrigeration in Pharmacy. Size reduction: Mechanism, factors influencing, energy requirements, applications in pharmacy, grinders i.e. fluid energy mill, hammer mill, ball mill and its variants, centrifugal mill, attrition mill, edge runner mill, colloid mill, squirrel cage disintegrator, Buhrstone mill.

#### **UCC 550 COMPUTER SCIENCE**

*6 Credits (4- 0 – 4)*

Computer fundamentals: Computer components, characteristics and classification of computers, hardware and software, peripheral devices. Algorithmic development: Techniques of problem solving, flowcharting, decision table, structured programming concepts, modular programming, algorithms for searching, sorting and merging. Programming methodologies: top down and bottom-up programming. Fortran: Data types operator and expression, input output statements, control statements- if, else, select case, do continue, do enddo, do while, exit, cycle, goto. Array processing – implied do, allocate, deallocate. Structures- array structures, nested structures. Function and subroutine: function subprogram, subroutine subprogram, passing arguments. Managing data files. Fortran 90: data types, control surfaces, arrays, pointers, subprograms, recursion. Study and programs for numerical and statistical methods: matrices, solution of linear equations, interpolating a function, numerical integration, solution of ordinary differential equation, measures of central tendency, dispersion, regression analysis, correlation coefficient. Internet: Definition, various activities on internet.

**PRACTICALS:** Number of experiments based on aforementioned theory.

#### **BPL 233 PHARMACEUTICAL CHEMISTRY – III (Pharmaceutical Physical Chemistry)**

*7 Credits (4 – 2 – 4)*

Behavior of gases: kinetic theory of gases, deviation from ideal behaviors and explanation. The liquid state: Physical properties (surface tension, parachor, viscosity, refractive index, optical rotation, dipole moments and chemical constituents. Solutions: Ideal and real solutions, solutions

of gases in liquids, colligative properties, partitions coefficient, conductance and its measurement, Debye huckel theory. Thermodynamics; first, second and third laws, zero law, absolute temperature scale, thermochemical equations, phase equilibrium and phase rule. Adsorption: Frudlich and Gibbs adsorption isotherms, Langmuir theory of adsorption. Photochemistry: Consequences of light absorption, Jablenski diagram, Lambert-Beer law, Quantum efficiency. Chemical Kinetics: Zero, first and second order reactions, complex reaction, theories of chemical kinetics, characteristics of homogeneous and heterogeneous catalysis, acid base and enzyme catalysis. Quantum mechanics: Postulates of quantum mechanics, operators in quantum mechanics, and the Schrödinger wave equation. Solution of electrolytes: Arrhenius theory of electrolytic dissociation, modern theory of strong electrolytes, and other coefficients for expressing colligative properties.

Ionic equilibria; Ostwalds dilution law, Lawry Bronsted and Lewis theory of acids and bases, ionization constants of weak acids and bases, ionic product of water. Electromotive force and oxidation-reduction systems: Nernst theory of electrode potential, reference electrodes, indicator electrodes, oxidation and reduction potential.

**PRACTICALS:** Number of experiments based on aforementioned theory

### **BPL 234 PHARMACEUTICAL CHEMISTRY- IV (Pharmaceutical Analysis -I)**

*7 Credits (4 – 2 – 4)*

Introduction: 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 and standard deviation, statistical treatment of small data sheets, selection of sample, precision and accuracy, fundamentals of volumetric analysis, method of expressing concentration, primary and secondary standards. Acid Base Titrations: acid base concepts, role of solvent, relative strength of acids and bases, ionization law, law of mass action, common ion effect, ionic product of water, pH, hydrolysis of salts, Henderson Hesselbach equation, buffer solutions, neutralization curves, acid-base indicators, theory of indicators, choice of indicators, mixed indicators, polyprotic system, polyamine and amino acid systems, amino acid titration, application in assay of  $H_3PO_4$ , NaOH,  $CaCO_3$  etc. Oxidation Reduction Titrations: concepts of oxidation and reduction, redox reactions, strength and equivalent weights of oxidizing and reducing agents. Theory of redox titrations, cell representations, measurement of electrode potential. oxidation-reductions, potassium iodate titrations, potassium bromate titrations, titanous chloride titrations, sodium 2,6- dichlorophenol idophenol titration, pharmaceutical applications. Precipitations Titrations: precipitation reactions, solubility products, effects of acids, temperature and solvent upon the solubility of a precipitate. Argentometric titrations, ammonium of potassium thiocyanate titrations, mercuric nitrate titrations, methods: Mohr's method, Volhards method, Fajans method and pharmaceutical applications. Gravimetric Analysis; preparation of Gooch crucible for filtration and use of sintered glass crucible, determination of water of hydration, some exercises to gravimetric analysis shall be covered. Non-aqueous Titrations; theoretical titrations, scope and limitations, acid base equilibria in non-aqueous media, titrations of weak bases, titrations of weak acids, indicators, pharmaceutical products, should be selected for illustration. Complexiometric Titrations: concept of complexation and chelation, Warner's co-ordination number and electronic structure of complex stability constants, titration curves, masking and demasking agents, types of complexometric titrations, metal ion indicators, factors influencing the stability of complexes, applications. Miscellaneous method of analysis; Diazotization titration, Kjeldahl nitrogen determination, Karl fishcher titration, determination of alcohol in liquid galenicals, oxygen flask combustion, Extraction procedure, separation of drug from Excipients, liquid-liquid extraction, separation of mixtures by extraction, distribution law, successive extraction, the Craig method of multiple extraction, continuous counter-current extraction, effect of temperature, pH, inert solute, association, ion-pair formation, the emulsion problem in extraction. Fundamentals of Chromatography Introduction and theory of underlying different types of chromatography techniques like- Column chromatography, thin layer chromatography, paper and circular chromatography, adsorbents and solvents used in these techniques. Electrochemistry: the electric cell, electrode potential, half cells, types of half cells, sign convention, Nernst equation, the salt bridge, activity series, standard potential, standard hydrogen electrode, measuring the relative voltage of half cells, calculations of standard potential, reference

electrodes, indicator electrodes. Potentiometry: theoretical considerations, ion-selective electrodes, measurement of potential, location of end point equipment, analytical application, direct measurement of a metal concentration, differential curve, determination of  $K_{sp}$ , pH measurement dead-stop titrations; pH meter, pH definition, relation to pH to potential, equipment and applications. Conductance and high frequency titrations and their applications. Coulometric titrations, its principles and applications, controlled potential coulometry, cell design, instrumentation, advantages and limitations, and electrode selection. Polarography and its applications: theory of mass transport processes, current processes, current potential relationship, polarization, choice of electrodes, effect of oxygen, instrumentation, calculation of concentration, laboratory design and safety. Amperometric titrations and its applications.

**PRACTICALS:** Number of experiments based on aforementioned theory

#### **Semester – IV**

#### **BPL 241 PHARMACEUTICS-IV (Pharmaceutical Microbiology)**

*7 Credits (4 – 2 – 4)*

Introduction to the science of microbiology-ancient theories concerning the origin of life, contribution of great scientists to this science, with particular reference to the contributions of the following scientists: A.V. Leeuwenhoek, Louis Pasteur, Edward Jenner, Robert Koch, Alexander Fleming, Joseph Lister. Microscopy: Microscopes, their magnification, resolution, illumination and filters, working of different types of microscopes, micrometry. Classification of microbes. Nutrition, cultivation isolation and identification of bacteria, fungi and viruses. Bacterial enzymes – classification, nomenclature, production by fermentation, extraction methods, immobilization techniques and applications of bacterial enzymes in general and detailed account of following bacterial enzymes : alpha amylase ( diastase ) and proteases. Disinfection, factors affecting disinfection, dynamics of disinfection, disinfectants and antiseptics and their evaluation. Sterilization, different methods, applications and evaluation of sterilization methods. Aseptic technique. Microbial standardisation of antibiotics ( ampicillin, streptomycin ), Vitamins ( Vitamin B-12, Niacin ) and calcium pantothenate. Fermentation: Types of media used; factors affecting, control of various parameters during fermentation. A detailed account of the industrial fermentation process for manufacture of penicillin, streptomycin, glutamic acid; Lysine, citric acid, Vit.B<sub>12</sub>.

**PRACTICALS:** Number of experiments based upon afore mentioned theory and including experiments devised to prepare various types of culture media, sub culturing of common aerobic and anaerobic bacteria, fungus and yeast, various staining methods, various methods of isolation and identification of microbes, sterilizing techniques and evaluation of sterilizing techniques, evaluation of aseptics and disinfectants, testing and sterility of pharmaceutical products as per I.P. requirements, evaluation of potency of antibiotics and vitamins etc.

#### **BPL 242 PHARMACEUTICAL CHEMISTRY – V (Pharmaceutical Biochemistry)**

*7 Credits (4 – 2 – 4)*

Energy, rich compounds, production of ATP, and its biological significance. Electron transport and biological oxidation. Enzymes: classification of enzymes, general mechanism of enzyme function, factors affecting the velocity of enzyme catalyzed reaction, activators and inactivators of enzymatic reaction. Clinical application of enzyme estimation. Isoenzyme, immobilization of enzymes. Metabolism of carbohydrates: an aerobic metabolism of glucose, aerobic metabolism of glucose (Kreb's cycle) pentose phosphate pathway, metabolism of galactose, glycogenesis, glycogenolysis, gluconeogenesis, regulation of blood glucose concentration. Metabolism of lipids: Oxidation of fatty acids oxidation of unsaturated fatty acids. Synthesis and degradation of triglycerides, hormonal influence of the mobilization of fat in adipose tissue, ketosis phospholipids, sphingolipids. Metabolism of proteins; nitrogen fixation, nitrogen balance, ammonia assimilation, nitrification and nitrate assimilation, amino acid degradation and urea cycle. Metabolism of phenyl-alanine and tryptophan. Metabolism of purines and pyrimidines: biosynthesis of RNA and DNA. Role of cyclic nucleotide in enzyme activation. Gene protein relationship, control of protein synthesis. Mutation, physical and chemical mutagenesis repair mechanism, genetic code, inborn error of metabolism. Biochemical role of trace elements.

**PRACTICALS:** Number of experiments based on aforementioned theory portion.

### **BPL 243 PHARMACOGNOSY-II**

*7 Credits (4 – 2 – 4)*

Phytochemical screening: Preparation of extracts, screening for alkaloids, saponins, sterols, flavonoids and tannins and anthraquinones, amino acids in plant extract. Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substituents, adulterants used, diagnostic microscopic and macroscopic features and specific chemical tests of following group of drugs containing glycosides: Saponins: liquorice, ginseng, dioscorea, Cardio-active sterols: digitalis, squill and thevetia. Anthraquinones cathartics: aloe, senna, rhubarb and cascara. Others: Psoralea, gentian, quassia. Study of tannins and tannin containing drugs like black catechu, gall, and myrobalan. Studies of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses of following indigenous drugs: Amla, Satavari, Tylophora, Bhilava, Punarnava, Apamarg, Gokhru, Brahmi, Arjuna, Ashoka, Lehsun, Guggal and Neem. Holistic concepts of Drugs administration in traditional systems of medicine. Introduction to ayurvedic preparations like arishtas, asavas, gutikas, tailas and bhasmas. 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: Pyridine-piperidine: tobacco and areca. Tropane: belladonna, hyoscyamus, datura, and withania. Quinoline and isoquinoline : Cinchona, ipecac, opium. Indole: ergot, rauwolfia, catharanthus and nux-vomica. Imidazoles: pilocarpus. Steroidal: kuruchi. alkaloidal amines: ephedra Purines: Coffee, tea Study of fibers used in pharmacy such as cotton, silk, wool, Introduction, classification and **PRACTICALS:** Number of experiments based on aforementioned theory portion and including the following: Identification of crude drugs listed in theory. Microscopic study of some important glycosides containing crude drugs as underlined above. Study of powdered drugs. Standardization of some traditional drug formulations. Studies of microscopic characters of some important drugs in entire and powdered form. Chemical evaluation of powdered drugs.

### **BPL 244 PHARMACEUTICS –V (Forensic pharmacy)**

*4 credits (4-0 -0)*

Introduction Pharmaceutical Professional bodies. - A brief review. Pharmaceutical Education- A brief review An elaborate (Practical orientation) study of the following Pharmaceutical Ethics. Pharmacy Act 1948. Drugs and Cosmetics Act 1940 and Rules 1945 Medicinal & Toilet Preparations (Excise Duties) Act 1955. Narcotic Drugs & Psychotropic Substances Act 1985 & Rules A brief study of the following with special reference to the main provisions. Poisons Act 1919

Drugs and Magic Remedies (Objectionable advertisements) Act 1954. Medical Termination of Pregnancy Act 1970 & Rules 1975. Prevention of Cruelty to Animals Act 1960. CPCSEA AICTE Act 1987. Patents Act. 1970.

## **B. Pharm IIIrd year syllabus**

**Semester – V.**

**BPL 351 PHARMACEUTICS –VI (Physical Pharmacy)**

*6 Credits (4-0-4)*

Micromeretic and Powder Rheology: Particle size and distribution, average particle size, number and weight distribution, particle number, method of determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods of determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties. Surface and Interfacial Phenomenon: Liquid interface, surface and interfacial tensions, surface free energy measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, electric properties of interface. Viscosity and Rheology: Newtonian systems, laws of flow, kinematic viscosity, effect of temperature, non Newtonian systems, pseudoplastic, dilatent, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers. Dispersion system: Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloid in pharmacy. Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, emulsions; types, theories and physical stability. Complexation: Classification of complexes, method of preparation and analysis, application. Kinetics and drug stability: general considerations & concepts, half life determination, influence of temperature, light, solvent, catalytic species and other factors, accelerated stability study, expiration dating. Buffers: Buffer equation and buffer capacity in general, buffer in pharmaceutical systems- buffered isotonic solutions, measurement of tonicity calculations, methods of adjusting isotonicity.

**PRACTICALS:** Number of experiments based upon aforementioned theory and including the following: Determination of latent heat, vapor pressure and critical point. Studies on polymorphs, their identification and properties. Determination of particle size, particle size distribution and surface areas using various methods of particle size analysis. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc. Determination of surface/interfacial tension, HLB values and critical micellar concentration of surfactants. Study of rheological properties of various types of systems using different viscometers. Studies of different types of colloid and their properties. Preparation of various types of suspensions and

determination of their sedimentation parameters. Preparation and stability studies of emulsions. Studies on different types of complexes and determination of their stability constants. Determinations of half-life rate constant and order of reaction. To study the influence of various factors on the rate of reaction. Accelerated stability testing, shelf life determination and expiration dating of pharmaceuticals. Preparation of pharmaceutical buffers and determination of buffer capacity. Experiments involving tonicity adjustments

### **BPL 352 PHARMACEUTICS-VII (Dosage Form Design)**

*6 Credits (4-0-4)*

Preformulation studies: Study of physical properties of drug like physical form, particle size, shape, density, wetting dielectric constant, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability. Study of chemical properties of drug like hydrolysis, oxidation, reduction, racemization, polymerization etc., and their influence on formulation and stability of products. Study of prodrugs in solving problems related to stability, bioavailability and elegance of formulation. Radiopharmaceuticals: fundamentals of radio pharmacy, therapeutic applications of isotopes, diagnostic applications of isotopes, use of radioisotopes in basic research, product development, product production, process control and quality control. Liquid formulations, formulation and industrial production of liquid and semi-solid formulation like suspension, syrup, emulsions and ointments. Skin: structure and physiology, physiology of sweating, physiology of skin secretions formulations, preparations for skin of face and hands, formulation, preparation and evaluation of cleansing creams, cold creams, cleansing lotions, foundation creams, moisturizing creams, skin tonics, hand and body lotion. Hairs, structure and functions, formulation, preparation and evaluation of shampoos, dandruff preparation, hair creams, and fixers, hair colorants, hair remover (depilatories), shaving sticks and after shave lotion. Formulation, preparation and evaluation of lipsticks. Formulation, preparation and evaluation of other cosmetics like nail lacquers, anti-perspirants and deodorants, tooth powders and tooth paste.

#### **PRACTICALS:**

Experiments illustrative of the portion covered in the theory portion of the syllabi and including the following: Formulation, preparation, packing and presentation of the following class of dosage forms using laboratory scale equipment's syrups, dry syrups drops, suspensions, solubilized systems, emulsions and topical applications. Preparation and quality control of (a) cold cream (b) vanishing cream (c) Cleansing lotion and creams (d) moisturizing creams (e) skin tonics, (f) hair creams and hair conditioners (g) shampoos (h) hair colorant (i) depilatory (j) shaving creams and sticks (k) tooth powder (l) tooth pastes (m) after shave lotions and other cosmetics. Experiments to illustrate comparative study of suspending agents, emulsifying agent and antioxidant preservatives. Preformulation studies including drug-excipient, compatibility studies, effect of stabilizers, preservatives etc. in dosage form design. Stability evaluation of various dosage forms and their expiring dating.

### **BPL 353 PHARMACEUTICAL CHEMISTRY-VI (Medicinal chemistry-I)**

*7 Credits (4-2-4)*

Basic Principles of Medicinal Chemistry: Physicochemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bioisotermism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding. Drug-receptor interactions- receptor concept, receptor- effector theories, types of receptor and their action including transduction mechanism and G proteins. Principles of drug design (Theoretical aspects). Traditional analog (QSAR), Computer aided drug designing (CADD), Molecular modeling. Combinatorial chemistry.

Mode of action, uses, Structure activity relationship including physicochemical properties of the following classes of drugs. Drugs acting at Synaptic and neuro-effector junction sites: Cholinergics and anticholinergics, antispasmodics, antiulcer drugs, ganglionic stimulants, Neuromuscular blocking agents, sympathomimetic agents including biosynthesis of adrenergic neurotransmitter, adrenergic drugs and adrenoceptor blockers. Autocoids: Antihistamines, Ecosanoids, Anti-inflammatory agents (nonsteroidal), analgesic and antipyretics. Drugs affecting Uterine Motility: Oxytocics including oxytocin, ergot alkaloids and prostaglandins. Diuretics and

Antidiuretics. Cardiovascular agents: Antihypertensives, Cardiotonics, Antiarrhythmics, antianginals, anticoagulants and antiplatelets, thrombolytics, antithrombolytics, hypolipoproteinemic drugs. Vitamins- Classification, chemistry of thiamine, pyridoxine, folic acid, ascorbic acid and vitamin A. Insulin and oral hypoglycemic agents. Thyroid and Antithyroid drugs. Synthetic procedures of following selected drugs – Neostigmine bromide, Cyclopentolate HCl, Propantheline bromide, Benzhexol, Diphenhydramine, Chlorpheniramine, Promethazine, Cyclizine, Sodium chromoglycollate, Aspirin, Ibuprofen, Indomethacin, Phenazone, Phenylbutazone, Oxyphenbutazone, Allopurinol, Probenecid, Furosemide, Acetazolamide, Chlorthiazide, Hydrochlorthiazide, Spironolactone, Triamterene, Nifedipine, Procainamide, Verapamil, Propranolol, Methyldopa, Clonidine, Guanethidine, Hydrallazine, Phentolamine, Clofibrate, Warfarin, Phenindione, Pyridoxine, Folic acid, Tolbutamide, Methylthiouracil, methimazole.

**PRACTICALS:** Number of experiments based on the above mentioned theory portion and including the following: Synthesis of selected drugs from the course content. Establishing the pharmacopoeial standards of drug synthesized.

### **BPL 354 PHARMACOLOGY-II**

*6 Credits (4-0-4)*

General Pharmacology-Introduction to Pharmacology, Sources of drugs, Routes of administration, receptors, agonists, antagonists, partial agonists, inverse agonists, functioning of G-proteins, synergistic effect and additive effect, factors modifying drug action, tolerance, dependence, tachyphylaxis, therapeutic index. Absorption, distribution metabolism and excretion of drugs, Principles of Clinical pharmacokinetics, Adverse Drug Reactions and Discovery and development of new drugs, Clinical trials. Pharmacology of Peripheral Nervous System: Neurohumoral transmission (autonomic and somatic) Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics Pharmacology of Central Nervous System: General Anesthetics. Sedatives, hypnotics, Anti-anxiety agents, Psychopharmacological agents (antipsychotics, antidepressants, Anti-epileptics Analgesics, Antipyretics, Anti-inflammatory and Anti-gout drugs. Narcotic analgesics

#### **PRACTICALS:**

Introduction to Experimental Pharmacology: To record the concentration response curve (CRC) of acetylcholine using rat ileum To study the effects of physostigmine and d-tubocurarine on the CRC of acetylcholine using frog rectus abdominus muscle preparation. Experiments on Central Nervous system: Recording of spontaneous motor activity; analgesia, anticonvulsant activity, muscle relaxant activity of drugs using simple experiments. To study the effect of autonomic drugs on rabbit eye.

### **UCC 551 PRESENTATION AND COMMUNICATION SKILLS**

Communication skills: Essentials of communication skills, small group communication techniques, group discussion etc. Public speaking techniques, body language – verbal and non-verbal cues, Interview – Kinds of interview-as interviewee, as interviewer. Workshops: Mock interviews, group discussions, JAM sessions [just a minute], dress codes. Presentation Skills: Pre-presentation preparation, presentation skills, post-presentation follow-up, Presentation aids- audio, visual, audio-visual and printed aids, computer aides presentations- use of power point. Meetings – Convening – Managing – Post meeting follow up : organizing, meeting manners, presiding over a meeting-participating in a meeting. Written presentation, Language of writing, preparation of C.V./Resume, official correspondence, report writing.

#### **Semester – VI.**

### **BPL 361 PHARMACEUTICS-VIII (Pharmaceutical Engineering)**

*7 Credits (4-2-4)*

Distillation: Raoult's law, volatility, boiling point diagrams, azeotropic mixtures, equilibrium diagrams, types of distillation, rectification, rectifying columns, downcomers, material and energy balance of a rectifying column, reflux ratio, determination of number of theory plates, H.E.T.P.

and steam distillation. Extraction: Factors affecting, equipment for extraction of solids i.e. fixed bed diffusion battery, continuous diffusion battery, basket extractor, Rotocel extractor and Dorr agitator; equipment for liquid-liquid extraction i.e. extraction towers and Podbielniak extractor. Mixing: Definition, objectives, mechanism, uniformity index, factors influencing selection of suitable mixer. Study of equipment employed for solid-solid, liquid-liquid and solid-liquid mixing. Emulsification equipment. Size separation: Screening equipment i.e. trommels, rotex and hummer; air suspension methods i.e. air separator and cyclone separators; hydraulic separation i.e. elutriation and double cone emulsifier. Crystallization: crystal forms, habit, Mier's supersaturation theory, crystallizers based on supersaturation, by cooling (i.e. tank crystallizers, agitated batch crystallizers and Swenson-Walker), adiabatic cooling (i.e. vacuum crystallizers) and evaporation (i.e. Krystal crystallizers). Material and energy balance of crystallizer. Corrosion and its prevention: Types of corrosion causes of corrosion and method for combating corrosion. Materials for pharmaceutical plant construction: factors affecting the selection of a material for pharmaceutical plant, ferrous metals (i.e. cast iron, steel and stainless steels), nonferrous metals (i.e. Copper and its alloys, aluminium, tin silver, nickel and alloys), nonmetals i.e. glass, slate, asbestos, rubber, plastics and timber. Industrial hazards and safety precautions: Mechanical-chemical-electrical-fire-dust hazards, safety requirements, accident records etc. Transportation of materials: Liquids: Pumps i.e. airlift, ejector, piston plunger, egg, diaphragm, gear, screw, centrifugal and self-priming. Gases: Ejectors, compressors, fans and blowers. Solids: Intermittent and continuous methods in vertical, horizontal and inclined plane. Introduction: Significance of Engineering Drawing in Pharmaceutical Industry, drawing instruments and their uses, lines, lettering and dimensioning. Scales: Construction of plain scales, vernier scale, diagonal scale, comparative scale and isometric scale. Isometric projections: Theory, isometric views and projections, construction of isometric projections/views of two-dimensional and three-dimensional objects. Orthographic projections: Theory, types, and construction of drawing in both first angle and third angle. Various methods of sectioning i.e. full section, half section, removed section, partial section, and offset section. Conversion of orthographic projections into isometric projections/views. Drawing of machine parts and simple pharmaceutical equipment. Methods of depicting layouts of various sections of a pharmaceutical unit.

**PRACTICALS:** Numbers of practical based on theory portions of Pharmaceutical Engineering-I and Pharmaceutical Engineering-II and including the following: To perform Reynold's experiment. Determination of fanning factor. Comparison of the sensitivity of various manometers. Determination of flow rate using venturimeter. Determination of flow rate using orificemeter. Determination of overall heat transfer coefficient. Effect of number of balls on the grinding rate in a ball mill. Efficiency of a centrifugal pump. Effect of thickness of cake on filtration rate in a filter press. Effect of colour on radiation of heat. Overall efficiency of steam distillation. Use of psychrometric chart. Flow rate using pitot tubes. Determination of equilibrium moisture constant.

### **BPL 362 PHARMACEUTICAL CHEMISTRY-VII (Heterocyclic compounds and Natural products)**

*5 Credits (4-2-0)*

Heterocyclic compounds: Study of fundamentals of heterocyclic compounds, nomenclature, method of synthesis and important chemical reactions of the following: Five membered Heterocycles: Furan, Thiophene, Pyrrole, Thiazole, oxazole, imidazole, Pyrazole, Triazole and Tetrazole. Six membered Heterocycles: Pyridine, pyridazine, Pyrimidine, Pyrazine, Pyrones. Benz-fused Heterocycles: Quinoline, Isoquinoline, Indole, Purines, Acidine, and lanthone. Carbohydrates: An account of the chemistry of Arabinose, Ribose, mannose, Glucose, fructose, Sucrose, Lactose, Cellulose, starch, Glycogen and dextrans, Structure elucidation of glucose, sucrose, starch. Proteins and Amino Acids: Isolation and general methods of synthesis of amino acids and physicochemical properties. General classification of proteins and end group analysis. Structural features of DNA and RNA. Study of chemistry of fixed oils, fats and waxes. Terpenes: Classification, Isoprene rule, Chemistry of various constituents of volatile oils: Limonene, Pinene, Cineole, Camphor, Menthol, Menthone, Thymol, Citral and Eugenol. Structure elucidation of Pinene, Limonene, Camphor, Citral. Glycosides: Classification and method of isolation of  $\alpha$  and  $\beta$ - d-methyl glucoside. Chemistry of salicin, cardiac glycosides, anthraquinone glycosides, saponins. Structure elucidation of cardiac glycosides.

### **BPL 363 PHARMACOLOGY- III**

*7 Credits (4-2-4)*

Pharmacology of Cardiovascular System: Digitalis and cardiac glycosides. Antihypertensive drugs. Antianginals, Antiarrhythmics, Antihyperlipidemics, Diuretics

Drugs Acting on the Hemopoietic System: Hematinics. Anticoagulants, Anti-platelet drugs.

Autacoids: Histamine, 5-HT and their antagonists. Prostaglandins, thromboxanes and leukotrienes. Angiotensin, Bradykinin and Substance P

Drugs Acting on the Respiratory System: Anti-asthmatic drugs including bronchodilators. Anti-tussives and expectorants. Drugs Acting on CNS Alcohols & Disulfiram Drug Addition and Drug Abuse CNS-stimulants Anti-Parkinsonian Agents

#### **PRACTICALS:**

Experiments on Isolated Preparations: To record the CRC of 5-HT on rat fundus preparation. To record the CRC of histamine on guinea pig ileum preparation. To record the CRC of oxytocin using rat uterus preparation. To find out the strength of the given sample on using a suitable isolated muscle preparation by Matching Assay, Three point assay

### **BPL 364 PHARMACOGNOSY-III**

*6 Credits (4-0-4)*

General technique of biosynthetic studies and basic metabolic pathways. An introduction to biogenesis of secondary Metabolites of pharmaceutical importance. Chemistry and biogenesis of medicinally important Monoterpenes, sesquiterpenes, diterpenes, and triterpenoids. Chemical and spectral approaches to simple molecules of natural origin. Concept of stereoisomerism taking examples of natural products. Carotenoids, beta-carotenoids, alpha-carotenes, vitamin A, xanthophylls of medicinal importance. Steroids: chemistry in biosynthesis of hecogenin, diosgenin and sarasapogenin. Alkaloids: chemistry and biogenesis of atropine and related compounds, quinine, reserpine, morphine, papaverine, ephedrine, ergot and Vinca-alkaloids. Chemistry of medicinal important irridoids.

Chemistry of penicillins, streptomycin and tetracyclines. study of different chromatographic methods and their application in evaluation of herbal drugs.

**PRACTICALS:** Number of experiments based on aforementioned theory portion and including the following: Laboratory experiments on isolation, separation, purification of various groups of chemical constituents of pharmaceutical importance. Exercises on paper and thin layer chromatographic evaluation of herbal drug constituents.

## **B.Pharm IV year syllabus**

### **Semester VII**

#### **BPL 471 Pharmaceutics-IX (Biopharmaceutics and Pharmacokinetics)**

*7 Credits (4-2-4)*

Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting. Biopharmaceutics: Passage of drug across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis). Factors influencing absorption-physiochemical, physiological and pharmaceutical. Drug distribution in the body, plasma protein binding. Pharmacokinetics. Significance of plasma drug concentration measurement. Compartmental model: definition and scope. Pharmacokinetics of drug absorption-zero order and first order absorption rate constant using wagner-Nelson and Loo-piegelman method. Volume of distribution and distribution coefficient. Compartment kinetics-one compartment and two compartment models. Determination of pharmacokinetics parameters from plasma and urine data after drug administration by intravascular and oral route. Curve fitting (method of residuals), regression procedures. Clearance concept, mechanism of renal clearance, clearance ratio, determination of renal clearance. Hepatic elimination of drugs, first pass effect, extraction ratio, hepatic clearance, biliary excretion, enterohepatic circulation. Non-linear pharmacokinetics with

special reference to one compartment model after I.V. drug administration, Michaelis-Menten equation, determination of non-linearity (saturation mechanism).

Clinical pharmacokinetics; Definition and scope. Dosage adjustment in patients with and without renal and hepatic failure. Dosage regimen adjustment for repeated therapy. Introduction to Pharmacokinetics drug interactions and its significance in combination therapy. Bioavailability and bioequivalence: Measures of bioavailability,  $C_{max}$ ,  $t_{max}$  and Area under Curve (AUC). Design of single dose bio-equivalence study and relevant statistics. Overview of regulatory requirements for conduction of bio-equivalence study.

**PRACTICALS:** Number of experiments based on aforementioned theory topics, should be conducted.

### **BPL 472 Pharmaceutical Chemistry-VIII (Medicinal Chemistry-II)**

*7 Credits (4-2-4)*

Drug metabolism. Functionalization reactions (Phase I)- Oxidation, reduction and hydrolytic reactions. Conjugation reactions: Glucuronic acid conjugation, sulphate conjugation, conjugation with amino acids, glutathione conjugation, acetylation, methylation. Chemistry and principles of prodrug design. Mode of action, uses, structure activity relationship including physicochemical properties of the following classes of drugs: Drugs acting on Central nervous System: General anesthetics, Local anesthetics, Hypnotics and sedatives, opioid analgesics, antitussives, anticonvulsants, antiparkinsonian drugs, CNS stimulants, psychopharmacological agents (neuroleptics, antidepressants, anxiolytics). Steroids and related drugs: Steroidal nomenclature and stereochemistry; androgens and anabolic agents; oestrogens and progestational agents; adrenocorticoids. Chemotherapeutic agents

Antibacterials including antimetabolites. Antibiotics (β-lactams, tetracyclines, aminoglycosides, polyenes, cycloserine, chloramphenicol). Antiviral agents including anti-HIV agents, Antineoplastics, Immunomodulators, Antifungals, Antimycobacterials, Anthelmintics. Antiprotozoals. Antiseptics and disinfectants. Urinary antiseptics. Synthetic procedure for following drugs: Procaine, Lignocaine, Cinchocaine, Thiopentone, Phenobarbitone, Hexobarbitone, Diazepam, Mehtaqualone, Phenytoin, Troxidone, Pethidine, N-methylmorphine, Chlorpromazine, Trifluoperazine, Amitriptyline, Nikethamide, Cholesterol, Dihydroepiandrosterone, Oestradiol, Diethylstilbesterol, Progesterone, Cortisone acetate, Diethyl carbamazepine, Thiabendazole, Sulphadiazine, Sulphamethoxazole, Trimethoprim, Chloramphenicol, Nalidixic acid, Norfloxacin, Nitrofurantoin, Isoniazid, Ethambutol, Clofazimine, Ketoconazole, Clotrimazole, Chlorambucil, Melphalan, Thio-TEPA, 5-Fluorouracil, Cisplatin.

**PRACTICALS:** Number of experiments based upon aforementioned theory portion.

### **BPL 473 Pharmaceutics-X (Packaging Technology)**

*5 Credits (4-2-0)*

Introduction: Definition, life history of a package, qualities of the package, purpose of packaging, hazards encountered by the package, various types of inner and outer packages, selection of a suitable package and child resistant package. Packaging materials: Detailed study with regard to composition packaging characteristics, advantages, economics and limitations of paper, glass, plastics, metals and rubber as packaging materials. Strip Packing: Significance of Strip Packing, advantages, economics and limitation of Strip Packing, Strip Packing machinery, films employed in Strip Packing (including composites and laminates) and evaluation of films and strips packs. Blister Packaging: Blister packing materials, significance of Blister packing, advantages, economics and limitation of blister packing, blister packing machinery, various types of blister packages, evaluation of blister package.

Pouch packaging: Materials used, advantages, economics and limitation of pouch packing, pouch packing machinery, spectrum of applications, evaluation of pouch packing. Liquid Formulation Packaging: Various containers/closures employed for liquid formulations. Machinery employed for liquid filling – constant level, volumetric, gravimetric etc. Evaluation of liquid formulation packages. Semi-Solid Packaging: Various types of containers/packages used for semi-solid products, filling and sealing machinery (including collapsible tube filling and sealing machine) merits and limitations of various packages, evaluation of semi-solid product package. Sterile

Product Packaging: General principles of packaging of sterile products. Various types of containers used for sterile products including small volume and large volume parenterals. Types of closures used for the sterile products. Sterile product filling and sealing machinery i.e. ampoule filling and sealing machine. Limitations and merits of various packages. Evaluation of the sterile product packages. Labeling: Types of label, Labeling requirements as per Drugs and Cosmetics act, packaging inserts and machinery employed for labeling.

#### **BPL 474 Pharmacognosy-IV**

*6 Credits (4-0-4)*

Role of medicinal and aromatic plants in national economy. World-wide trade in medicinal plants and derived products with special reference to diosgenin (dioscorea), taxol (taxus sps), digitalis, tropane alkaloid containing plants, datura, cinchona, ipecac, liquorice, ginseng, Aloe vera, Valerian, rouwolfia and plant containing laxatives (Senna, Rhubarb). A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India, Utilization and production of phytoconstituents of poppy, ergot, tropane alkaloids (Belladonna), vinca, aloes, digitalis, dioscorea Utilization of aromatic plants and derived products with special reference to menthol, citral, sandwood oil, vetiver oil, geranium oil and eucalyptus oil. Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance. Application of plant tissue culture in pharmacognosy. Chemotaxonomy of medicinal plants. Marine pharmacognosy, novel medicinal agents from marine sources. Natural allergens and photosensitizing agents. Natural colours, Plant bitters and sweeteners

**PRACTICALS:** Number of experiments based on aforementioned theory and including the following: Isolation of some selected phytoconstituents studied in theory. Extraction of volatile oils and their chromatographic profiles. Some experiments in plant tissue culture.

#### **Semester VIII**

#### **BPL 481 Pharmaceutics-XI ( Pharmaceutical Technology)**

*7 Credits (4-2-4)*

Tablets: types of tablets, formulation of tablets, various granulation techniques including slugging, chilsonator, extruder and granulator. Tableting machinery for production of single layer, multilayer and compression. coated tablets. Physics of tablet compression, strain gauge, Tablet coating: sugar coating, film coating and compression coating, coating processes i.e. air suspension coating and pan coating (using conventional, rear vented and perforated pans). Quality control of tablets. Process validation. Capsules: advantages, applications, formulation, large scale production and quality control of hard and soft capsules. Microencapsulation: terminology, advantages and applications. Study of various processes employed for microencapsulation i.e. coacervation phase separation, multiorifice centrifuge, electrostatic deposition, vacuum deposition, spray drying, spray congealing, polymerization, complex emulsion, air suspension technique and pan coating. Aerosols: definitions, advantages and applications, liquified-gas system, compressed gas system, propellants, containers, valves, cold-filling process, pressure filling process and quality control of aerosols. Parenterals: types of parenteral products, formulation, production facilities, production procedures for small volume and large volume Parenterals, large scale production of injectable grade water and quality control of parenterals. Design, development, production and evaluation of oral controlled release preparations.

**PRACTICALS:** Number of experiments based on aforementioned theory and including the following; Microencapsulation by coacervation phase separation brought about by change of temperature. Microencapsulation by coacervation phase separation brought about by addition of nonsolvent. Formulation, preparation and evaluation of pediatric tablets. Preparation and evaluation of aspirin tablets. Coating of tablets. Evaluation of coatings. Granulation by slugging. Determination of BA and M/G factor. Formulation of hard capsules. Quality control of soft and hard capsules. Preparation of small volume parenterals. Test for pyrogen. Preparation and evaluation of large volume parenteral. Formulation, preparation and evaluation of aerosol. Microencapsulation by complex emulsion method.

#### **BPL 482 PHARMACOLOGY - IV**

#### 5 Credits (4-2-0)

Drugs Acting on the Gastrointestinal Tract: Laxatives and antidiarrhoeal agents. Emetics and anti-emetics. Anti-ulcer agents

Pharmacology of Endocrine System: Insulin, oral hypoglycemic agents & glucagon. ACTH and corticosteroids. Androgens and anabolic steroids. Oral contraceptives Oxytocics Chemotherapy: General principles of chemotherapy. Sulphonamides and co-trimoxazole. Antibiotics: Penicillins, Cephalosporins, Chloramphenicol, Erythromycin, Quinolones and Miscellaneous Antibiotics. Principles of Toxicology:

Definition of poison, general principles of treatment of poisoning with a particular reference to organophosphorus and atropine poisoning. Heavy metals and heavy metal antagonists viz. arsenic, lead and mercury.

#### **BPL 483 Pharmaceutical Chemistry-IX (Pharmaceutical Analysis-II)**

##### 7 Credits (4-2-4)

Gas chromatography: introduction, principles of gas chromatography, basic GLC apparatus, sample introduction, column, column efficiency, solid support, liquid phases, branches of gas chromatography, detectors, temperature effect, allocation of GLC in pharmaceutical analysis. HPLC: introduction and nomenclature, instrumentation, liquid solid chromatography, liquid liquid chromatography, exclusion chromatography, HPLC columns, solvent selection in HPLC, data handling in HPLC, application of HPLC. TLC quantitative estimate. Ion exchange and molecular sieve processes. Theory of ion exchange, types of exchangers, ion-exchange equilibria, ion-exchange capacity, ion-exchange separation, applications in pharmaceutical analysis, molecular sieve separation and application. Quality Assurance: Philosophy of GLP, ISO-9000, TQM, quality Review and Quality documentation. Regulatory aspects: Legislation & regulatory control, regulatory drug analysis, interpretation of analytical data. Validation /Quality audit. Quality of equipment, Validation of equipment, Validation of analytical procedures. The theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques should be thoroughly studied: Ultraviolet and visible spectrophotometry. Fluorimetry. Infrared spectrophotometry. Nuclear magnetic resonance spectroscopy including  $^{13}\text{C}$  NMR. Mass spectroscopy. Flame photometry. Emission spectroscopy. Atomic absorption spectroscopy. Radioimmunoassay and radioactivity as an analysis tool; basic nuclear properties, measurement of radioactivity, analytical applications of radioactivity, interaction of radiation with matter, counting statistics errors and corrections and radiation safety.

**PRACTICALS:** Number of experiments based on aforementioned theory portion and including the following: Using official procedure involving instrumental techniques, carry out the quantitative estimation of at least ten formulations containing single drug or more than one drug. Using flame photometry, carry out the estimation of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$  ions. Carry out the IR of samples having different functional groups ( $-\text{COOH}$ ;  $-\text{COOR}$ ,  $\text{CONHR}-1^\circ$ ,  $2^\circ$ ,  $3^\circ$ ;  $-\text{NH}_2$ ,  $-\text{NHR}$ ,  $-\text{OH}$ , etc.) Workshop to interpret the structure of samples organic compounds using UV, IR, NMR and MS.

#### **BPL 484 Pharmaceutics-XII (Pharmaceutical Management)**

##### 4 Credits (4-0-0)

Principles of Management (CO-ordination, Communication, Motivation, decision making, Leadership, innovation, Creativity, Delegation of Authority, Responsibility, Managerial qualities.

Accountancy: Principles of Accountancy, Ledger posting and book entries. Economics: Principles of economics with special reference to the laws of demand and supply, Pharmaceutical Marketing: Functions; buying, selling, transportation, storage, finance, feedback information, channels of distribution, wholesale, retail, departmental store, multiple shop Salesmanship: Principles of sale promotion, advertising, ethics of sales, 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.

Management: The concept, scope, functions and principles of management, Management and administration, Evolution of management. Human Resource Management: A brief exposure of human resource management - HR planning, recruitment, selection, training, performance appraisal, positive attitude.