SYLLABUS FOR THE POSTS OF DRUGS ANALYST IN THE DEPARTMENT OF AYUSH

CHEMISTRY B.Sc(Chemistry)	UGC MODEL CURRICULUM, 2001 CHEMISTRY
MICROBIOLOGY B.Sc(Microbiology)	UGC MODEL CURRICULUM, 2001 MICRO-BIOLOGY
BOTANY B.Sc(Botany)	UGC MODEL CURRICULUM, 2001 BOTANY
PHARMACY B.PHARMA	RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES B.PHARMA SYLLABUS

UGC MODEL CURRICULUM

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2001

Chemistry

B.Sc. FIRST YEAR

Paper I CH-101 Inorganic Chemistry – I — 60 Hrs (2 Hrs/week)

I Atomic Structure — 6 Hrs

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of ψ and ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge

II Periodic Properties — 5 Hrs

Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

III Chemical Bonding — 20 Hrs

(A) Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2^- and H_2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

(B) Ionic Solids – Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories.

(C) Weak interactions – Hydrogen bonding, van der Waals forces

IV s-Block Elements — 6 Hrs

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

V p-Block Elements — 20 Hrs

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron-diborane

and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.

VI Chemistry of Noble Gases — 3 Hrs

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

PAPER II

CH-102 Organic Chemistry – I — 60 Hrs (2 Hrs/week)

I Structure and Bonding — 5 Hrs

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

II Mechanism of Organic Reactions — 8 Hrs

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles. Types of organic reactions. Energy considerations.

Reactive intermediates — carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

III Stereochemistry of Organic Compounds — 12 Hrs

Concept of isomerism. Types of isomerism.

Optical isomerism — elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism — determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism — conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Difference between configuration and conformation.

IV Alkanes and Cycloalkanes — 7 Hrs

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with

special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes.

Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes — nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring: banana bonds.

V Alkenes, Cycloalkenes, Dienes and Alkynes — 12 Hrs

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes — mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration–oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$. Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

Methods of formation, conformation and chemical reactions of cycloalkenes.

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions — 1,2 and 1,4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

VI Arenes and Aromaticity — 8 Hrs

Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain.

Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: the Huckel rule, aromatic ions.

Aromatic electrophilic substitution — general pattern of the mechanism, role of σ- and π-complexes. Mechansim of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.

VII Alkyl and Aryl Halides — 8 Hrs

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams.

Polyhalogen compounds: chloroform, carbon tetrachloride.

Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

PAPER III

CH-103 Physical Chemistry – I — 60 Hrs (2 Hrs/week)

I Mathematical Concepts and Computers — 16 Hrs

(A) Mathematical Concepts

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like k_x, e^x, x^n, sin x, log x; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions; permutations and combinations. Factorials. Probability.

(B) Computers

General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmatic; introduction to computer languages. Programming, operating systems.

II Gaseous States — 8 Hrs

Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state.

Critical Phenomena : PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect).

III Liquid State — 6 Hrs

Intermolecular forces, structure of liquids (a qualitative description).

Structural differences between solids, liquids and gases.

Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholestric phases. Thermography and seven segment cell.

IV Solid State — 11 Hrs

Definition of space lattice, unit cell.

Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements in crystals.

X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

V Colloidal State — 6 Hrs

Definition of colloids, classification of colloids.

Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.

Liquids in liquids (emulsions): types of emulsions, preparation. Emulsifier.

Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids.

VI Chemical Kinetics and Catalysis — 13 Hrs

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life. Determination of the order of reaction – differential method, method of integration, method of half life period and isolation method.

Radioactive decay as a first order phenomenon.

Experimental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometer.

Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy,

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis, characteristics of catalysed reactions, classification of catalysis, miscellaneous examples.

SECOND YEAR

PAPER V

CH-201 Inorganic Chemistry – II **60 Hrs (2 Hrs/week)**

I Chemistry of Elements of First Transition Series **10 Hrs**

Characteristic properties of d-block elements.
Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

II Chemistry of Elements of Second and Third Transition Series **10 Hrs**

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry

III Oxidation and Reduction **8 Hrs**

Use of redox potential data – analysis of redox cycle, redox stability in water – Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

IV Coordination Compounds **10 Hrs**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes

V Chemistry of Lanthanide Elements **6 Hrs**

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

VI Chemistry of Actinides **4 Hrs**

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides

VII Acids and Bases **6 Hrs**

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

VIII Non-aqueous Solvents **6 Hrs**

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

PAPER VI

CH-202 Organic Chemistry – II — 60 Hrs (2 Hrs/week)

I Electromagnetic Spectrum: Absorption Spectra — 10 Hrs

Ultraviolet (UV) absorption spectroscopy — absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones.

Infrared (IR) absorption spectroscopy — molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and Interpretation of IR spectra of simple organic compounds.

II Alcohols — 6 Hrs

Classification and nomenclature.

Monohydric alcohols — nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols.

Dihydric alcohols — nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement.

Trihydric alcohols — nomenclature and methods of formation, chemical reactions of glycerol.

III Phenols — 6 Hrs

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols — electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

IV Ethers and Epoxides — 3 Hrs

Nomenclature of ethers and methods of their formation, physical properties. Chemical reactions — cleavage and autoxidation, Ziesel's method.

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

V Aldehydes and Ketones — 14 Hrs

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction.

Use of acetals as protecting group. Oxidation of aldehydes, Baeyer–Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones.

An introduction to α,β unsaturated aldehydes and ketones.

VI Carboxylic Acids — 6 Hrs

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids. Hydroxy acids: malic, tartaric and citric acids.

Methods of formation and chemical reactions of unsaturated monocarboxylic acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

VII Carboxylic Acid Derivatives — 3 Hrs

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

VIII Organic Compounds of Nitrogen — 12 Hrs

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Halonitroarenes: reactivity. Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.

Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

PAPER VII

CH-203 Physical Chemistry – II — 60 Hrs (2 Hrs/week)

I Thermodynamics – I — 12 Hrs

Definition of thermodynamic terms: system, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law - Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: standard state, standard enthalpy of formation- Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

II Thermodynamics -II — 13 Hrs

Second law of thermodynamics: need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of entropy: entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

III Chemical Equilibrium — 5 Hrs

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle.

Reaction isotherm and reaction isochore – Clapeyron equation and Clausius -Clapeyron equation, applications.

IV Phase Equilibrium — 10 Hrs

Statement and meaning of the terms – phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system – water, CO_2 and S systems.

Phase equilibria of two component system – solid-liquid equilibria, simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions – compound formation with congruent melting point (Mg-Zn) and incongruent melting point, ($NaCl-H_2O$), ($FeCl_3-H_2O$) and $CuSO_4-H_2O$) system. Freezing mixtures, acetone -dry ice.

Liquid – liquid mixtures - Ideal liquid mixtures, Raoult's and Henry's law. Non-ideal system-azeotropes – $HCl-H_2O$ and ethanol – water systems.

Partially miscible liquids – Phenol-water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature.

Immiscible liquids, steam distillation.

Nernst distribution law – thermodynamic derivation, applications.

V Electrochemistry – I — 10 Hrs

Electrical transport -conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.

Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

VI Electrochemistry - II — 10 Hrs

Types of reversible electrodes – gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes- standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K), polarization, over potential and hydrogen overvoltage.

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pK_a determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods.

Buffers – mechanism of buffer action, Henderson-Hazel equation. Hydrolysis of salts.

Corrosion – types, theories and methods of combating it.

THIRD YEAR

PAPER IX

CH – 301 Inorganic Chemistry – III — 60 Hrs (2 Hrs/week)

I Hard and Soft Acids and Bases (HSAB) — 7 Hrs

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

II Metal-ligand Bonding in Transition Metal Complexes — 10 Hrs

Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

III Magnetic Properties of Transition Metal Complexes — 7 Hrs

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

IV Electron Spectra of Transition Metal Complexes — 7 Hrs

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

V Thermodynamic and Kinetic Aspects of Metal Complexes — 5 Hrs

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

VI Organometallic Chemistry — 10 Hrs

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, a brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

VII Bioinorganic Chemistry — 10 Hrs

Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Nitrogen fixation.

VIII Silicones and Phosphazenes — 4 Hrs

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

PAPER X

CH – 302 Organic Chemistry – III **60 Hrs (2 Hrs/week)**

I Spectroscopy 10 Hrs

Nuclear magnetic resonance (NMR) spectroscopy.

Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

II Organometallic Compounds 4 Hrs

Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions.

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

III Organosulphur Compounds 4 Hrs

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

IV Heterocyclic Compounds 8 Hrs

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six- membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

V Organic Synthesis *via* Enolates 6 Hrs

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.

Alkylation of 1,3-dithianes. Alkylation and acylation of enamines

VI Carbohydrates — 8 Hrs

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation.

Structures of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

VII Amino Acids, Peptides, Proteins and Nucleic Acids — 6 Hrs

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids.

Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid–phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation.

Nucleic acids: introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

VIII Fats, Oils and Detergents — 2 Hrs

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

IX Synthetic Polymers — 4 Hrs

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers.

Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes.

Natural and synthetic rubbers.

X Synthetic Dyes — 8 Hrs

Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo

PAPER XI

CH 303 Physical Chemistry – III **60 Hrs (2 Hrs/week)**

I Elementary Quantum Mechanics **20 Hrs**

Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect.

De Broglie hypothesis, the Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

Molecular orbital theory, basic ideas – criteria for forming M.O from A.O, construction of M.O's by LCAO - H_2^+ ion,calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics. Hybrid orbitals – sp, sp^2, sp^3; calculation of coefficients of A.O.'s used in these hybrid orbitals.

Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

II Spectroscopy **20 Hrs**

Introduction: electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diatomic molecules. Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Vibrational Spectrum

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Raman Spectrum: concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Electronic Spectrum

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.

Qualitative description of σ, π- and n M.O., their energy levels and the respective transitions.

III Photochemistry 8 Hrs

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions - energy transfer processes (simple examples).

IV Physical Properties and Molecular Structure 5 Hrs

Optical activity, polarization – (Clausius – Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties –paramagnetism, diamagnetism and ferromagnetics.

V Solutions, Dilute Solutions and Colligative Properties 7 Hrs

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

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2001

B.Sc. MICROBIOLOGY

SYLLABUS

FIRST YEAR

101. General Microbiology and Basic Biochemistry

P 101. Basic techniques in general microbiology and basic biochemistry

SECOND YEAR

201. Microbial physiology and genetics

P 201. Microbial physiology and genetics

THIRD YEAR

301. Molecular biology and genetic engineering

302. Immunology and clinical microbiology

303. Environmental and Agricultural Microbiology

304. Food and Industrial Microbiology

P301. Molecular biology and genetic engineering

P302. Immunology and Clinical Microbiology

P303. Environmental and Agricultural Microbiology

P304. Food and industrial microbiology

Ancillary – 1

Inorganic, Organic & Physical Chemistry

Ancillary – 2

Computers and Bio-Statistics

Ancillary – 3

Biochemistry

Ancillary – 4

Principles of Bioinstrumentation and techniques

Ancillary – 5

Entomology and Parasitology

B.S. MICROBIOLOGY

Syllabus

FIRST YEAR

101. General Microbiology and Basic Biochemistry

Unit 1

Unity of microbial world, Scope of Microbiology, Microbiology and Human health, Beneficial and Harmful microbes. Development of microbiology (contributions of pioneers)

Unit 2

Diversity of microbial world: Principle of classification, Classification of viruses, Bacteria (including Cyanobacteria) algae and Fungi (including yeasts)

Unit 3

Methods for studying microorganims: Origin of microbes, Microscopy, Pure culture techniques, Sterilization, Aseptic techniques, Isolation of pure culture, Conditions and media for growth of microorganisms in the Laboratory.

Unit 4

Biochemistry of microbes: Chemical elements, Structure of atoms, Molecules and Chemical bonds, Chemical reactions, Molecules of living systems, pH and pK, Buffers, Carbohydrates, Lipids, Proteins, DNA & RNA.

Unit 5

Structure of archae prokaryotic and Eukaryotic cells: Plasma membrane, Transport across membrane, Cell surface, Energy transformation.

P 101. Basic Techniques in General Microbiology and Basic Biochemistry

Preparation of culture media: solid/liquid

Sterilization techniques.

Isolation of single colonies on solid media.

Enumeration of bacterial numbers by serial dilution and plating.

Simple and differential staining.

Determination of antibiotic resistance of bacteria.

Estimation of DNA and RNA by measurement of sugar.

Estimation of protein.

Estimation of blood glucose – glucose oxidase method.

Estimation of serum cholesterol – cholesterol oxidase method.

Liver function tests.

Estimation of biliubin.

SECOND YEAR

201. Microbial Physiology and Genetics

Unit 1

Bacterial morphology and ultrastructure: composition, structure and biosynthesis of cell wall in Gram positive and Gram negative bacteria. Physiology of bacterial growth, phases of growth, growth conditions. Differentiation in bacterial cells – sporulation, germination. Bacterial cell division, replication of bacterial chromosome, co-ordination of cell division with replication of chromosome, partitioning of chromosome into daughter cells.

Unit 2

Primary and Secondary metabolism

Unit 3

Bacterial plasmids: structure and properties, replication, incompatibility, plasmid amplification.

Bacteriophages: lytic development cycle – T4; lytic and lysogenic development of phage λ; Single stranded DNA phages.

Transposition: structure of bacterial transposons, types of bacterial transposons. Mechanism of antibiotic resistance and spread of antibiotic resistance.

Unit 4

Genetic recombination: requirements, molecular basis, genetic analysis of recombination in bacteria.

Bacterial genetics: concepts of haploid genomes, genetic exchange through conjugation, transformation and transduction (generalized and specialized).

Transformation: natural transformation, competence, DNA uptake, role of natural transformation, artificially induced competence, electroporation.

Conjugation: self transmissible plasmids, F factor, *tra* genes, *ori*T, F' and Hfr strains, steps in conjugation, chromosome mobilization, transfer systems in Gram Positive bacteria.

DNA repair and restriction: Types of repair systems. restriction endonuclease, various types of restriction enzymes, their properties and uses. Methylation – dependent restriction enzymes, *dam* and *dcm* methylases.

Gene expression: transcription, translation and control of expression in microbes.

Unit 5

Mutations: spontaneous and induced, base pair changes, frameshifts, deletions, inversions, tandem duplications, insertions, useful phenotypes (auxotrophic, conditional lethal, resistant), reversion vs. suppression, Ames test.

P 201. Microbial Physiology and Genetics

Determination of growth phase of E.coli by measurement of OD and colony forming units, Relationship between OD and cfu measurements, Measurement of growth by dry weight and wet weight – *Penicillium spp.* Determination of antibiotic resistance by plating method.

Isolation of E.coli plasmid DNA by rapid method and separation by agarose gel electrophoresis.

Transformation of E.coli: preparation of competent cells, determination of viable counts, efficiency of plasmid transformation.

Infection of E.coli with phage T4, determination of phage titre by plating method.

Induction of lac operon: culture of E.coli, induction by IPTG, measurement of b-galactosidase activity over a time period of 2 hr.

Conjugation in *E. coli* using plate method.

THIRD YEAR

301. Molecular Biology and Genetic Engineering

Unit 1

History of molecular biology, model systems, concepts of molecular biology, Early history of genetic engineering, genetic engineering concepts, ethical issues.

Unit 2

Structure of biological macromolecules. proteins, lipids and carbohydrates nucleic acids, chemical structure of bases, phosphodiester bond, hydrogen bond. higher order structure, proteins, aminoacid structure, folding of proteins, proteins with subunits, enzyme.

Unit 3

Function of macromolecules: Early observation on the mechanism of heredity, DNA as genetic material, basic mechanism of replication, enzymes involved in replication, enzymes involved in transcription mechanism, translation, genetic code, regulation of gene expression. transcription, translation and control of expression in microbes.

Unit 4

DNA repair and restriction, types of repair systems, restriction modification systems, types of restriction enzymes, properties and uses, methylation.

Biology of plasmids. Bacteriophages, lytic vs lysogenic phages, single stranded DNA phages, M13, restriction modification systems, restriction enzymes.

Unit 5

Plasmid and phage vectors, restriction and ligation of vector and passenger DNA, transformation of host cells, selection vs screening of recombinant colonies, analysis of recombinant clones, DNA sequencing, protein separation and identification methods.

302. Immunology and Clinical Microbiology

Unit 1

Historical background, innate and acquired immunity, humoral and cell mediated immunity, organs and cells involved in immune response, identification and characterization of T and B cells, cell surface receptors, cellular cooperation, MHC restriction, antigen characteristics, types of antigens, adjuvants, immunogenicity, antigenicity, antigen –antibody reactions.

Unit 2

Humoral immune response, immunoglobulin structure and properties, theories of antibody diversity, isotype switching, monoclonal antibodies, antigen – antibody reactions, complement, complement Activation.

Unit 3

Characterisation and types of T cells - macrophage activation, cytokines, types of hypersensitivity, antibody dependent cell mediated cytotoxicity, principles of serological test methods with examples.

Unit 4

Diseases caused by certain specific pathogens *Staphylococcus aureus, Streptococcus Pneumoniae, Mycobacterium tuberculosis, Salmonella typhi, Vibrio cholerae,* Human Immuno Deficiency Virus, Hepatitis Virus, *Entamoeba histolytica, Plasmodium* species, Dermatophiles, collection and transport of appropriate clinical samples for clinical diagnostics.

Unit 5

Elements of chemotherapy, principles, drug – microbe – host interaction, basic mechanism of drug action, drug resistance, major antimicrobial agents, non automated *in vitro* drug susceptibility testing, rapid test for antimicrobial susceptibility, general principles and clinical use of antimicrobial drugs.

303. Environmental and Agricultural Microbiology

Unit 1

Aerobiology: definition – droplet nuclei – aerosol – assessment of air quality – some important air borne diseases caused by bacteria, fungi, virus their symptoms and preventive measures.

Unit 2

Soil microbiology: physical and chemical characteristics and microflora of various soil types, rhizosphere – phyllosphere – brief account of microbial interactions – symbiosis – mutualism – commensalism – competition – amensalism – synergism – parasitism – predation – rumen microbiology, biofertilizers – biological nitrogen fixation – nitrogenase enzyme – nif genes – symbiotic nitrogen fixation – (*Rhizobium, Frankia*) – non symbiotic nitrogen fixation (*Azotobacter* – *Azospirillum*), VAM – ecto – endo – ecterndomycorrhizae.

Unit 3

Major biogeochemical cycles and the organisms: carbon – nitrogen – phosphorous and sulphur – a brief mention about biodegradation – xenobiotics – bioaccumulation – biopesticides – deterioration.

Unit 4

Aquatic microbiology: ecosystems – fresh water (ponds, lakes, streams – marine (estuaries, mangroves, deep sea,), water zonations – upwelling – eutrophication – food chain, potability of water – microbial assessment of water quality – water purification – brief account of water borne diseases and preventive measure.

Unit 5

Waste Treatment: types of wastes – characterization of solid and liquid wastes – waste treatment and useful byproducts, solid – saccharification – gasification – composting – liquid waste treatment – aerobic – anaerobic methods.

304. Food and Industrial Microbiology

Unit 1

Food as a substrate for micro-organism, micro-organisms important in food microbiology-molds, yeasts and bacteria, brief account of each group, general characteristics and importance, principles of food preservation – asepsis - removal of microorganisms, anaerobic conditions - high and low temperatures – drying - chemical preservatives - food additives.

Unit 2

Food spoilage and food bome infections, general principles underlying food spoilage and contamination, canned food-sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish, seafood and poultry-spoilages, food poisoning-infective and toxic, bacterial and non-bacterial, general methods of their diagnosis.

Unit 3

General concepts of industrial microbiology, principles of exploitation of micro-organisms and their products, screening, strain development strategies, immobilisation methods, adsorption; covalent linkages - advantages and disadvantages, raw materials used in media production, industrial sterilization, fermentation equipment and its uses, types of fermentation-single, batch, continuous, dual or multiple, surface, submerged and solid state fermentation.

Unit 4

Food fermentations and food produced by microbes, bread, cheese, vinegar, fermented dairy products and oriental fermented foods, microbial cells as food-single cell proteins; mushroom cultivation, production of alcohol and fermented beverages, beer and wine.

Unit 5

Industrial Products derived from microbes, industrial enzymes-amylase, proteinase, cellulase, aminoacid production - glutamic acid and lysine. production of antibiotics penicillins, streptomycins, vitamins - riboflavin, cyanocobalamin. Vaccines - genetic recombinant vaccines.

P 301. Molecular Biology and Genetic Engineering

Characterization of genetic markers of known bacterial strains.

Phage growth curve.

Isolation of DNA from bacteria.

Isolation of DNA and plasmid DNA and restriction analysis.

Simple cloning using plasmid DNA as vector and transformation of competent *E. coli* cells.

Electrophoretic analysis of proteins.

THIRD YEAR

P 302. Immunology and Clinical Microbiology

Selection, collection and transport of specimens, blood samples, sera for microbiological and Immunological investigations.

Preparation of different types of culture media for growing pathogenic bacteria.

Staining techniques such as Gram's staining, AFB staining, Albert's staining and Giemsa's staining.

Preparation of buffers, reagents.

Tissue culture techniques and demonstration of handling of animals.

Separation of lymphocytes from blood and counting in haemocytometer.

Agglutination Tests (Haemagglutination and haemolysis techniques), blood grouping and widal test.

Precipitation test – single radial immuno diffusion, immuno electrophoresis, separation of serum proteins by electrophoresis.

Enzyme linked immunosorbant assay.

Isolation and identification of major bacterial pathogens such as *Staphylococcus aureus* and *E. coli*.

P 303. Environmental and Agricultural Microbiology

Enumeration and isolation of soil microorganisms agar plate technique, direct microscopic and enrichment culture technique – bacteria, fungi, protozoa, virus, from different soil types, preparation of Winogradsky column to study various soil microflora, isolation of *Rhizobium, Frankia.*

Techniques for microbial sampling of air from various sources, assessment of air quality by solid, liquid impingement techniques and enumeration of them by plating technique and turbidometric method.

Bacterial examination of water for potability, micro-organisms, *E. coli Staphylococci faecalis* as indicators of pollution, MPN index – IMVIC test – Endo agar.

Testing of water, soil, and sewage for physico-chemical parameters including COD and BOD, anaerobiosis, biomethanation

Field trip to ponds/coastal areas and surveying the area for various above said characters.

P 304. Food and Industrial Microbiology

Bacteriological analysis of food products; Direct microscopic studies and Standard plate count in milk.

Reductase test for milk: dye reduction test.

Isolation of micro organisms from common food items such as curd, Panmasala and bread.

ANCILLARY – 1

Inorganic, Organic & Physical Chemistry

Unit 1

a) **Hydrogen:** Isotopes of hydrogen – separation of the isotopes – properties and uses of heavy hydrogen – position of hydrogen in the Periodic Table – ortho and para hydrogen – separation difference in structure and properties – hydrides – definition – classification – preparation and properties.

b) **Oxides:** Definition – classification – properties.

c) **Water:** Hardness of water – types of hardness – removal of hardness – industrial implications of hardness in water – estimation of hardness by EDTA method (outline only) – units for hardness of water.

d) **Hydrogen peroxide:** Manufacture, properties, structure and uses of hydrogen peroxide – estimation of hydrogen peroxide by permanganimetry – strength of hydrogen peroxide in volume – strength, normality and percentage –calculation of strength on these different terms.

e) **Ozone:** Manufacture, composition, structure and properties.

Unit 2

a) Detection and estimation of nitrogen and halogens in organic compounds – empirical formula – molecular formula – structural formula – calculation of E.F. and M.F. from percentage composition.

b) Nature of valency of carbon in organic compounds – brief outline hybridizations sp^3, sp^2 and sp with one example for each – tetrahedral arrangement of valency of carbon.

Bond – breaking and bond – forming in organic reactions – homolytic cleavage – heterolytic cleavage – reaction intermediates – formation, stability and reactions of carabonium ion, carbanion and free radicals.

c) Nucleophiles – Electrophiles, definition, types and examples – specific reactions involving these.

d) Types of reactions – substitution – addition – elimination – rearrangements and polymerisation – illustration with specific examples.

Unit 3

a) Gaseous state, Postulates of kinetic theory of gases – derivation of expression for pressure of gas on the basis of kinetic theory – deducing the basic gas laws. Derivation of real gases

ANCILLARY – 2

Computers and Bio-Statistics

Unit 1

Introduction to Computers – classification of computers – computer generation – low, medium and high level languages – software and hardware – operating systems – compilers and interpreters - personal, mini, main frame and super computers, their characteristics and application, BIT, BYTE, WORD, computer memory and its types; data representation and storage– binary codes, binary system and its relationship to Boolean Operations.

Unit 2

Microsoft Excel – Data entry – graphs – aggregate functions – formulas and functions (students are expected to be familiar with all operations). different number systems and conversions input-output devices, secondary storage media.

Unit 3

Nature and scope of statistical methods and their limitations compilation, classification, tabulation and applications in life sciences – graphical representation – measures of average and dispersion stem and leaf plots; Box and whisker plots, coplots. introduction to probability theory and distributions (concepts without derivations) binomial, poisson and normal (only definition and problems).

Unit 4

Correlation and Regression – concepts of sampling and sampling distribution – tests of significance based on t, chi-square and F for means, proportions, variances and correlation efficient, theory of attributes and tests of independence of contingency tables.

Unit 5

Sampling methods – simple Random, stratified, systematic and cluster sampling procedures, sampling and non-sampling errors, principles of scientific experiments – analysis of variance – one way and two way classification – CRD, RBD and Latin Square Designs.

Note: The emphasis is solely upon the application, understanding the practice of statistical methods with specific References to problems in microbiology/life-sciences.

from ideal behaviour – reasons for deviation. derivation of vander Waals gas equation – explanation of behaviour of real gases on the basis of vander Waals gas equation.

b) Average, RMS and most probable velocities (equations only – no derivation) relationship between these different velocities. Liquefaction of gases – critical phenomenon – modern methods – Joule – Thomson effect – inversion temperature.

Unit 4

a) Structure of atom: Rutherford model of the atom – defects of Rutherford model, Bohr model of an atom – merits and demerits – Sommerfeld modification – wave theory – de Broglie's concept – dual nature – Heisenberg's uncertainty principle – difference between orbit and orbital – shapes of atomic orbitals.

b) **Bonding:** (i)V.B. theory: Postulates of V.B. theory – application to the formation of simple molecules like H_2, and He. Overlap of atomic orbitals – s-s, s-p, and p-p, overlap – principle of hybridization. (ii) M.O. theory: Formation of M.Os – bonding and antibonding and non-bonding M.O.s – M.O diagram for H_2, He and F_2.

ANCILLARY – 3

Biochemistry

Unit 1

Protein and nucleic acid structure and conformation, allosteric proteins, enzymes structure and kinetics, biological membrane.

Unit 2

Metabolism, basic concepts, carbohytrate, lipid and nucleic acid metabolism, photosynthesis.

Unit 3

Biosynthesis of macromolecules, lipids hormones, aminoacids nucleotides.

Unit 4

DNA transactions, gene concepts, DNA replication repair and recombination, protein synthesis, control of gene expression.

Unit 5

Membrane transport, cell walls, hormone action, muscle contraction, clinical applications of biochemistry.

ANCILLARY – 4

Principles of Bioinstrumentation and Techniques

Colorimetry and spectrophotometry

Spectrofluorimetry, turbidometry, nephelometry, luminometry

Electrophoretic techniques: proteins and nucleic acids.

Chromatography: adsorption, partition, gas, ion exchange, gel filtration, affinity, HPLC, FPLC.

Radioisotope techniques: nature of radioactivity, detection, measurements, counters, safety aspects.

Biosensors

Centrifugation and ultracentrifugation

Microscopy – light, phase contrast, fluorescence, dark field, electron microscopy.

Laser confocal microscopy and digital image analysis

Animal tissue culture

Decontamination, sterilization and disinfection.

Chemical synthesis of nucleotides and peptides

Sequencing of proteins and nucleic acids

Cytogenetics

Enzyme purification and assay techniques.

ANCILLARY – 5

Entomology and Parasitology

Unit 1

Entomology and disease transmission: Modern concepts of entomology, knowledge of the biology and lifecycles of arthropod vectors- ticks, mites, fleas, mosquitoes and flies that are capable of transmitting diseases in humans and animals, mechanism of disease transmission with particular References to vectors and diseases in India, vector control measures.

Unit 2

Parasitology - General concepts and Protozoalogy: introduction to parasitology classification-host parasite relationships, pathogenic mechanisms, transmission and life-cycles protozoa - *Entamoeba* and human disease, *Leishmania, Trypanosoma, Giardia, Trichomonas, Balantidium, Toxoplasma,Cryptosporidium* and other protozoan parasites causing human infections.

Unit 3

Helminthology: classification, Cestodes - *Taenia solium, T. saginata, T. echinococcus*, Trematodes- *Fasciola hepatica, Fasciolopsis buski, Paragonimus westermanii, Schistosomes*, Nematodes - *Ascaris, Ankylostoma, Trichuris, Trichinella, Enterobius, Strongyloides* and *Wucherhirhia*. their lifecycles, transmission and pathogenicity.

Unit 4

Laboratory techniques in parasitology: Examination of faeces for ova and cysts - worm burden, concentration methods, floatation and sedimentation techniques staining by Iron haemotoxylin method, blood smear examinations-thick/thin smears- cultivation of protozoan parasites.

Unit 5

Parasitic infections in immuno compromised hosts and AIDS patients, *Cryptosporidial* diarrhoea, *Giardiasis, Strongyloides*, infection and *Toxoplasmosis*, their diagnosis and treatment.

UGC MODEL CURRICULUM

BOTANY

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NEW DELHI

2001

B.SC. (GENERAL)

First Year

Course I. Diversity of microbes and cryptogams

Course II. Cell biology and genetics

Second Year

Course III. Diversity of seed plants and their systematics

Course IV. Structure, development and reproduction in flowering plants

Third Year

Course V. Plant physiology, biochemistry and biotechnology

Course VI. Ecology and utilization of plants

Detailed Curriculum

of

B.Sc. (General)

B.SC. (GENERAL) DIVERSITY OF MICROBES AND CRYPTOGAMS

Viruses and Bacteria: General account of viruses and mycoplasma; bacteria - structure, nutrition, reproduction and economic importance; general account of cyanobacteria.

Algae: General characters, classification and economic importance; important features and life history of Chlorophyceae - *Volvox, Oedogonium, Coleochaete;* Xanthophyceae – *Vaucheria;* Phaeophyceae - *Ectocarpus, Sargassum*; Rhodophyceae - *Polysiphonia*.

Fungi: General characters, classification and economic importance; important features and life history of Mastigomycotina - *Pythium, Phytophthora*; Zygomycotina – *Mucor*; Ascomycotina - *Saccharomyces, Eurotium, Chaetomium, Peziza;*. Basidiomycotina – *Puccinia, Agaricus*; Deuteromycotina - *Cercospora, Colletotrichum*; general account of Lichens.

Bryophyta: Amphibians of plant kingdom displaying alternation of generations; structure, reproduction and classification of Hepaticopsida (e.g. *Marchantia*); Anthocerotopsida (e.g. *Anthoceros*), Bryopsida (e.g. *Funaria*).

Pteridophyta: The first vascular plants; important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida; structure, reproduction in *Rhynia, Lycopodium, Selaginella, Equisetum, Pteris* and *Marsilea*.

COURSE II. CELL BIOLOGY AND GENETICS

Structure and function of nucleus: Ultrastructure; nuclear membrane; nucleolus.

Chromosome organization: Morphology; centromere and telomere; chromosome alterations; deletions, duplications, translocations, inversions; variations in, chromosome number, aneuploidy, polyploidy; sex chromosomes.

DNA the genetic material: DNA structure; replication; DNA-protein interaction; the nucleosome model; genetic code; satellite and repetitive DNA.

Cell division: Mitosis; meiosis.

Genetic inheritance: Mendelism; laws of segregation and independent assortment; linkage analysis; allelic and non-allelic interactions.

Gene expression: Structure of gene; transfer of genetic information; transcription, translation, protein synthesis; tRNA; ribosomes; regulation of gene expression in prokaryotes and eukaryotes; proteins, 1D, 2D and 3D structure.

Genetic variations: Mutations, spontaneous and induced; transposable genetic elements; DNA damage and repair.

Extranuclear genome: Presence and function of mitochondrial and plastid DNA; plasmids.

Structure and function of other organelles: Golgi, ER, peroxisomes, vacuoles.

The cell envelopes: Plasma membrane; bilayer lipid structure; functions; the cell wall.

COURSE III. DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS

1. Characteristics of seed plants; evolution of the seed habit; seed plants with (angiosperms) and without (gymnosperms) fruits; fossil and living seed plants.
2. General features of gymnosperms and their classification; evolution and diversity of gymnosperms; geological time scale, fossilization and fossil gymnosperms.
3. Morphology of vegetative and reproductive parts; anatomy of root, stem and leaf; reproduction and life cycle of *Pinus*, *Cycas* and *Ephedra*.
4. Angiosperms: origin and evolution. Some examples of primitive angiosperms.
5. Angiosperm taxonomy; brief history, aims and fundamental components (α -taxonomy, β-taxonomy, holotaxonomy); identification, keys, taxonomic literature.
6. Botanical nomenclature: Principles and rules; taxonomic ranks; type concept; principle of priority.
7. Classification of angiosperms; salient features of the systems proposed by Bentham and Hooker and Engler and Prantl.
8. Major contributions of cytology, phytochemistry and taximetrics to taxonomy.
9. Diversity of flowering plants as illustrated by members of the families Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae and Poaceae.

COURSE IV. STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS

1. The basic body plan of a flowering plant – modular type of growth.
2. Diversity in plant form in annuals, biennials and perennials; convergence of evolution of tree habit in gymnosperms, monocotyledons and dicotyledons; trees - largest and longest-lived organisms.
3. **The shoot system:** the shoot apical meristem and its histological organization; vascularization of primary shoot in monocotyledons and dicotyledons; formation of internodes, branching pattern; monopodial and sympodial growth; canopy architecture; cambium and its functions; formation of secondary xylem; a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; role of woody skeleton; secondary phloem – structure-function relationships; periderm.
4. **Leaf:** origin, development, arrangement and diversity in size and shape; internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.
5. **The root system:** the root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.
6. **Flower:** a modified shoot; structure, development and varieties of flower; functions; structure of anther and pistil; the male and female gametophytes; types of pollination; attractions and rewards for pollinators; pollen-pistil interaction, self incompatibility; double fertilization; formation of seed -- endosperm and embryo; fruit development and maturation.
7. **Significance of seed** – suspended animation; ecological adaptation; unit of genetic recombination and replenishment; dispersal strategies.
8. **Vegetative reproduction:** vegetative propagation, grafting, economic aspects.

COURSE V. PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOTECHNOLOGY

Basics of enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity; mechanism of action.

Plant-water relations: Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transport of water and transpiration; physiology of stomata.

Mineral nutrition: Essential macro- and micro-elements and their role; mineral uptake; deficiency and toxicity symptoms.

Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation.

Photosynthesis: Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration.

Respiration: ATP – the biological energy currency; aerobic and anaerobic respiration; Kreb's cycle; electron transport mechanism (chemi-osmotic theory); redox potential; oxidative phosphorylation; pentose phosphate pathway.

Nitrogen and lipid metabolism: Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation; structure and function of lipids; fatty acid biosynthesis; β-oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.

Growth and development: Definitions; phases of growth and development; kinetics of growth; seed dormancy, seed germination and factors of their regulation; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; biological clocks; physiology of senescence, fruit ripening; plant hormones – auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, biosynthesis and mechanism of action; photomorphogenesis; phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.

Genetic engineering: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; techniques of gene mapping and chromosome walking.

7

Botany

Biotechnology: Functional definition; basic aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of *Agrobacterium*; vectors for gene delivery and marker genes; salient achievements in crop biotechnology.

COURSE VI. ECOLOGY AND UTILIZATION OF PLANTS

ECOLOGY

Plants and environment: Atmosphere (gaseous composition), water (properties of water cycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties), and biota.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity.

Population ecology: Growth curves; ecotypes; ecads.

Community ecology: Community characteristics, frequency, density, cover, life forms, biological spectrum; ecological succession.

Ecosystems: Structure; abiotic and biotic components; food chain, food web, ecological pyramids, energy flow; biogeochemical cycles of carbon, nitrogen and phosphorus.

Biogeographical regions of India.

Vegetation types of India: Forests and grasslands.

UTILIZATION OF PLANTS

Food plants: Rice, wheat, maize, potato, sugarcane.

Fibres: Cotton and jute.

Vegetable oils: Groundnut, mustard and coconut.

General account of sources of firewood, timber and bamboos.

Spices: General account.

Medicinal plants: General account.

Beverages: Tea and coffee.

Rubber.

Revised Ordinance Governing

BACHELOR OF PHARMACY (B.Pharm)

Degree Course

RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES KARNATAKA

4th 'T' Block, Jayanagar, Bangalore 560041

Syllabus

I B.Pharm

1.1: HUMAN ANATOMY AND PHYSIOLOGY (Theory)

1. Scope of Anatomy and Physiology, basic terminologies used in this subject.

. Structure of cell – Its components and their functions

3. Elementary tissues of the human body: epithelial, connective, muscular and Nervous tissues-their sub-types and characteristics

4. a) Osseous system – structure, Classification of Bones, composition of Bones, functions of the skeleton.
   b) Classification of joints, types of movements of joints and
   c) Disorders of joints (definitions only)

5. Haemopoietic system
   a) Composition and functions of blood
   b) Haemopoiesis and disorders of blood & its components (Definition of Disorders)
   c) Blood groups
   d) Clotting factors and mechanism
   e) Platelets and disorders of coagulation

6. Lymph
   a) Lymph and lymphatic system; composition, formation and circulation
   b) Disorders of Lymph and lymphatic system (Definitions only)
   c) Spleen: Physiology and function

7. Cardio vascular system
   a) Anatomy of heart
   b) Blood vessels and circulation
   c) Pulmonary and systemic circulation
   d) ECG
   e) Cardiac cycle and Heart Sounds
   f) Blood Pressure maintenance and regulation

   Definitions of the following disorders

   i) Hypertension
   ii) Hypotension
   iii) Arteriosclerosis
   iv) Atherosclerosis
   v) Angina
   vi) Myocardial infarction
   vii) Congestive Heart failure and
   viii) Cardiac arrhythmias

8. Respiratory System
   a) Anatomy of respiratory organs and functions
   b) Mechanism and regulation of Respiration
   c) Physiology of respiration: transport of respiratory gases
   d) Respiratory volumes and vital capacity
   e) Definitions of: Hypoxia, Asphyxia, Dysbarism, Oxygen therapy and Resuscitation

9. Digestive System
   a) Anatomy of Gastro Intestinal Tract (GIT)
   b) Secretions functions and anatomy of
   i) Salivary glands
   ii) Stomach
   iii) Liver
   iv) Pancreas
   v) Intestine
   c) Disorders of GIT (definitions only)
   d) Digestion and absorption

10. Nervous Systems
    a) Definitions and classification of Nervous system
    b) Functional areas and functions of cerebrum
    c) Cerebellum
    d) Pons and Medulla
    e) Thalamus and Hypothalamus
    f) Basal ganglion
    g) Spinal cord: Structure and reflexes-Mono-Poly-Plantar
    h) Cranial Nerves-Names and functions
    i) ANS-anatomy and functions of sympathetic and parasympathetic nervous system 2

11. Urinary System
    a) Parts of Urinary system and Gross structure of the kidney
    b) Structure of Nephron
    c) Formation of Urine
    d) Rennin Angiotensin System- Juxta -Glomerular apparatus, Acid Base balance.
    e) Clearance tests and Micturition

12. Endocrine System
    a) Pituitary gland
    b) Adrenal gland
    c) Thyroid and parathyroid gland
    d) Pancreas and gonads

13. Reproductive System
    a) Male and female reproductive systems
    b) Their hormones – physiology of menstruation
    c) Spermatogenesis and Oogenesis
    d) Sex determination (genetic basis)
    e) Pregnancy and its maintenance and parturition
    f) Contraceptive devices

14. Sense Organ-Structure and functioning of
    a) Eye
    b) Ear
    c) Skin
    d) Taste and Smell

15. Skeletal muscles
    a) Histology
    b) Physiology of muscle contraction
    c) Physiological properties of skeletal muscle performance (Definition of the disorders)

16. Sports physiology
    a) Muscles in Exercise
    b) Effect of athletic training on muscles and muscle performance
    c) Respiration in exercise
    d) CVS in exercise
    e) Body heat in exercise
    f) Body fluids and salt in exercise
    g) Drugs and athletics

1.2: PHARMACEUTICS (Theory)

1. Historical background and development of profession of pharmacy and Pharmaceutical Industry in brief.

2. Development of Indian pharmacopoeia and introduction to other Pharmacopoeias such as B.P., U.S.P, European pharmacopoeia, Extra Pharmacopoeia and Indian National Formulary.

3. a) Introduction to dosage forms: Classification and definitions.
   b) Prescription: Definition, parts of prescription and handling
   c) Posology: Definition, factors affecting dose selection, calculation of children and Infant doses.

4. Different types of weights and measures, calculations involving percentage of solutions, alligation, proof spirit, isotonic solutions.

5. Introduction to different types of processes: Fusion, desiccation, sublimation, exsiccation and ignition. Definition of evaporation, distillation and drying. Various types of Baths; Water bath, Steam bath, Oil bath and Solvent bath

6. Galenicals: Definition, equipment for different extraction processes: Expression infusion, decoction, maceration and percolation, method of preparation of spirits, tinctures, extracts, soxhlet extraction.

7. Surgical aids: Definition and types of surgical sutures and ligatures. Manufacture and standardization of surgical catgut.

8. Powders and granules: Classification, advantages and disadvantages, preparation of simple, compound powders, insufflations, dusting powders, Eutectic and explosive powders, tooth powders and effervescent granules.

9. Monophasic dosage forms: Theoretical aspects including commonly used vehicles, essential adjuvants like stabilizers, colorants, and flavors with examples. Study of following monophasic liquids like gargles, mouthwashes, throat paints, eardrops, nasal drops, liniments and lotions, enemas, colloidions, syrups, elixirs and solutions.

10. Biphasic dosage forms: Suspensions: Definition and classification, diffusible and indiffusible suspensions, advantages and disadvantages.

    Emulsions: Definition, types of emulsions, identification tests emulsifying agents, creaming and cracking of emulsions

11. Suppositories and pessaries: Definition, advantages and disadvantages, types of bases, method of preparation, displacement value.

12. Incompatibilities: Introduction, Physical and Therapeutic incompatibility andmethods of overcome to same.

.3: PHARMACOGNOSY (Theory)

1. Definition, history and scope of Pharmacognosy.

2. Classification of drugs viz. alphabetical, morphological, chemical, pharmacological, taxonomical and chemotaxonomical methods. General aspects of chemotaxonomy.

3. Cultivation, collection, processing and storage of crude drugs. Conservation of medicinal plants.

4. Detailed methods of cultivation of the following drugs :
   a) Senna b) Cinchona c) Isapgol
   d) Cardamom e) Opium f) Ergot

5.Study of morphological, microscopical and cell wall constituents of crude drugs:
   a) Study of cell wall constituents and cell inclusions.
   b) Study of morphology and microscopy of different plant parts.
      i. Leaf: Datura, Senna
      ii. Bark: Cinnamon (Cassia), Cinchona
      iii. Wood: Quassia
      iv. Stem: Ephedra
      v. Root: Rauwolfia, Liquorice
      vi. Rhizome: Ginger, Podophyllum
      vii. Flower: Clove
      viii. Fruits: Coriander, Fennel
      ix. Seeds: Isapgol, Nux Vomica

6.Study of Natural Pesticides : Pyrethrum, Neem, Tobacco

7. Study of plant constituents:
   a) Brief study of various plant constituents.
   b) Detailed study of primary cell constituents: Carbohydrates and related products.
   c) Biological source, method of production, chemical constituents, tests, uses & adulterants of:
      I) Isapgol
      ii) Linseed
      iii) Honey
      iv) Acacia
      v) Agar
      vi) Sterculia
      vii) Tragacanth
      viii) Cellulose and its products
      ix) Pectin
      x) Guar gum
      xi) Sodium alginate.

8. Lipids:
   a) Definition, method of extraction, chemistry and method of analysis
   b) Study of method of production, chemical constituents, tests, uses and adulterants of the following oils:

   i) Castor oil ii) Shark liver oil iii) Chaulmoogra oil iv) Wool fat
   v) Bees wax vi) Spermaceti vii) Coca butter viii) Olive oil

9. Proteins:
   a) Definition, Classification, Chemistry, method of analysis

   b) Study of collagen, gelatin and its products.

10. Study of plant fibers used in surgical dressing and related products.

11. Different methods of adulteration of crude drugs and general methods for detection of adulterants.

1.4: PHARMACEUTICAL ORGANIC CHEMISTRY I (Theory)

1. Structure and physical properties:
   a) Polarity and dipolemoment: Hydrogen bonding and its applications and Protic and aprotic solvents.
   b) Tautomerism, Kets enol tautomerism.
   c) Reaction intermediates -carbocations, carbanions and free radicals
   d) Attacking reagents-electrophiles, nucleophiles.
   e) Acids and bases: Lowry Bronsted and Lewis theories.
   f) An introduction to Isomerism.

2. Nomenclature of organic compounds belonging to the following classes: alkanes, alkenes, dienes, alkynes, alcohols, aldehydes, ketones, amides, amines, phenols, alkyl halides,
   carboxylic acids, esters, acid chlorides and cycloalkanes. Concept of aromaticity, Huckel's rule
   nomenclature of aromatic compounds.

3. Free radical chain reactions of alkanes-mechanism, relative reactivity and stability.

4. Alicyclic compounds: Preparation of cycloalkanes, Bayer's strain theory, theory of stainless ring, molecular orbital concept.

5. Nucleophilic aliphatic substitution mechanism: nucleophiles, and leaving groups, kinetics of second and first order reaction. Mechanism and Stereochemistry of SN^2 reaction, Mechanism and Stereochemistry of SN1 reaction. Rearrangement of carbocation, SN^2 versus SN^1 reactions,
   Reactivity of alkyl halides in SN^1 and SN^2, Factors Affecting SN^1 and SN^2.

6. Dehydrohalogenation of alkyl halides: 1, 2 elimination, kinetics, E_2, E_1 mechanisms, E_2 versus E_1, elimination versus substitution. Dehydration of alcohols and its mechanism, orientation and reactivity in E_2 ,E_1. Saytzeff's and Hoffman's elimination.

7. Electrophilic addition: Reactions at carbon-carbon double bond, hydrogenation, Markovnikov's rule, addition of hydrogen halides, Addition of hydrogen bromides-peroxide effect. Electrophilic addition mechanism. Mechanism of cycloaddition reactions with examples. Addition of carbenes to alkenes, Diel's Alder reaction.

8. Theory of resonance: allyl radical as a resonance hybrid, stability, and orbital picture. Resonance stabilization of allyl cations: hyper conjugation, stability of conjugated dienes, mechanisms of 1,2 and 1,4-additions with examples, effect of temperature on 1, 2 and 1,4 addition.

9. Electrophilic aromatic substitution; Effect of substituent groups, determination of orientation, determination of relative reactivity, classification of substituent groups.
   mechanism of nitration, sulphonation, halogenation, Friedel craft alkylation and Friedel craft's acylation,

Reactivity and orientation, activating and deactivating (o, m, p, directing) groups, orientation and synthesis, orientation in disubstituted benzenes, theory of reactivity, theory of orientation, effects of halogens.

10. Nucleophilic additions in aldehydes and ketones, mechanisms with examples. Action of grignard reagent. Aldol condensation, crossed Aldol condensation, claisen condensation, cannizaro, crossed cannizaro reaction, benzoin's, perkins, knoevenagels and reformatsky reaction.

11. Nucleophilic acyl substitution in carboxylic acid derivatives, comparision with nucleophilic addition reaction, ionization of carboxylic acids, acidity of acids, structure of carboxylater ion, effect of substituents on acidity. Conversion of acids to acid chloride, amide, ester, anhydrides.

12. Migration to electron deficient nitrogen – Hofmanns, Beckmanns, Curtius, Smith. Diazotisation and Diazonium salts and its applications, Sandmeyers Diazocoupling reactions. Basicity of amines, effect of substituents on basicity. Acidity of phenols, effect of substituents on acidity. Kolbe's reaction, Reimer Tiemann reaction, Fries rearrangement, Willliamson's synthesis.

1.5: PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

1. Sources and effects of impurities in pharmacopoeial substances, importance of limit test, general principles and procedures for limit tests for chloride, sulphate, iron, arsenic, lead and heavy metals. Special procedures for limit tests.

2. General methods of preparation, assays*, storage condition & medicinal uses of inorganic compounds belonging to the following classes. (Assays*)

2.1 Medicinal Gases: Oxygen, Nitrous oxide, Carbon dioxide

2.2 Gastrointestinal agents Acidifiers: dil Hcl

Antacids: Aluminium hydroxide gel, Calcium carbonate, Sod. bicarbonate*,Magnesium trisilicate, Magnesium carbonate (light and heavy), Magnesium hydroxide mixture* and Zinc oxide*.

Protective and adsorbents: Kaolin and Talc,

Cathartics: Magnesium sulphate*, Sodium orthophosphate, Sodium sulphate.

2.3 Major intra and extra cellular electrolytes, major physiological ions and electrolytes used for the replacement therapy, physiological acid base balance, electrolyte combination therapy ORS, Sodium chloride injection, Dextrose and Sodium chloride injection, Calcium gluconate injection.

2.4 **Topical agents and dermatological preparations: Protective: Talc, Zinc oxide, Zinc stearate, Titanium dioxide.**

Antimicrobials: Potassium Permanganate*, chlorinated lime*, Iodine preparations, Boric acid*, Borax.

2.5 Dental products: Dentifrices, anticaries agents, desensitizing agents, calcium carbonate, sodium fluoride, Stannous fluoride, Zinc chloride, Zinc eugenol cement.

2.6 Miscellaneous agents:

Expectorants	:	Ammonium chloride (Formal method), Potassium iodide.
Haematinics	:	Ferrous sulfate*, Ferrous gluconate, Ferrous Fumarate, Iron dextran injection, Iron and Ammaonium citrate.
Emetics	:	Copper sulphate*.
Poisons and antidotes :		Sodium thiosulphate, Charcoal, (activated)
Pharmaceutical Aids	:	Bentonite, Sodium metabisulphite, Barium sulphate*.

3. Sources of errors, types of errors, methods of minimizing errors, accuracy, precision.

4. Fundamentals of volumetric analysis, theory of indicators and methods of expressing concentration. Primary and secondary standards. Preparation, standardization and storage of various volumetric solutions like oxalic acid, sodium hydrooxide, hydrochloric acid, sodium thiosulfate, potassium permanganate and Iodine solution.

4.1 Principles of redox titrations: Concepts of oxidation and reduction. Redox reactions, strength and equivalent weights of oxidizing and reducing agents, theory of redox titrations, iodometry, iodometry, bromometry, titrations with potassium iodate, potassium bromate, titanous chloride, 2,6-dichlorophenol indophenol.

4.2 Theory of nonaqueous titrations, classification of solvents used in nonaqueous titrations, estimation of Sodium Benzoate by nonaqueous titrations.

4.3 Principles of precipitation titrations, different methods-Mohr's, Modified Mohr's, Volhard's, Modified Volhard's, Fajans with example. Estimation of sodium chloride.

4.4 Principles of complexometric titrations, different types of complexometric titrations, methods of detecting the endpoints in complexometric titrations with example and estimation of calcium Gluconate.

1.6: MATHEMATICS

1. Matrices: Definition of matrices, Addition, Subtraction, multiplication of matrices, inverse of a square matrix, solution of linear simultaneous equations by matrix method, the characteristic equation of a matrix statement of Cayley-Hamilton Theorem (without proof) – examples pharmaceutical applications of determinations and matrices, Determinants of order two & order three,adjoint kramer's rule

2. Trigonometry:
Relations between the sides and angles of a triangle, Solution of triangle.

3. Analytical Geometry:
Point : Distance formula – Examples.
Straight line : General form of the equation to a straight line, slope of the line. slope point form. Condition for two lines to be parallel and perpendicular, angle between two lines, Perpendicular distance form the point to the line, Distance between parallel lines
Circle : General equation of a circle, finding center and radius of the circle.
Parabola : Derivation of standard equation in the form : $Y^2=4ax$.

4. Differential Calculus:
Limit of a function, derivative of a function, Differentiation of a sum, Product and quotient,
Differentiation of composite functions, Implicit functions, parametirc functions, Logarithmic differentiation, differentiation of exponentials, logarithmic,trigonometric, universe trigonometric functions, successive differentiation, Leibritz Theorem for nth order derivative of a product, partial
differentiation, Euler's theorem on homogenous functions of two variables.

5. Integral Calculus:
Indefinite integrals, integration by substitution and integration by parts important properties of definite integrals.

6. Differential Equations:
Definition formation of differential equations, differential equations of the first order and first degree, Methods of solving ordinary differential equations: variables seperable, homogenous, linear, exact. Differential equations and equations reducible to these forms, exact differential equations, linear differential equations with constant coefficients (higher order), homogeneous
linear differential equations, simultaneous linear differential equations of the first order, pharmaceutical applications.

7. Laplace Transforms:
Definition, Laplace transforms of elementary functions, properties of linearity and shifting, applications of differential equations using laplace transforms.

I B.Pharm
1.6: BIOLOGY (Theory)

Part A. BOTANY

1. General organization of the plant and plant cell and its inclusions.
2. The plant tissues (Meristematic and permanent).
3. The broad classification of the plant kingdom.
4. Morphology of the plant parts like root, stem and leaf and their modifications.
5. Inflorescence , flower and its pollination.
6. Morphology of fruits and seeds.

7. Plant taxonomy: Study of different families viz. Leguminous, Umbelliferae, Solanaceae, Liliaceae, Zingiberaceae and Rubiaceae with special reference to medicinal plants.

8. Plant Physiology: Transpiration, Photosynthesis, Respiration and Growth.

9. The study of 1) Fungi : eg. Yeast, Penicillin., 2) Bacteria.

Part B. ZOOLOGY

1. The study of Animal Cell, Animal tissues, Differences between plant and animal cell.

2. The detailed study of frog.

3. The study of representatives of Pices, Reptiles and Aves with special reference to the medicinal values.

4. General organization of a mammal.

5. The study of poisonous animals.

1.7: COMPUTER SCIENCE AND STATISTICS (Theory)

PART A: STATISTICS

1. Definition, data frequency, distribution, Classification of data. General graphical representation of the data: histogram, Frequency curve and frequency polygon and Ogive. Semilog line graph. Use of semilog scale-examples.

2. Measures of central tendency: Arithmetic mean, geometric mean and harmonic mean. Median, Mode, Calculation of quartiles and percentiles deciles.

3. Measures of dispersion: Range, quartile deviation, Mean deviation, Standard deviation, variance, coefficient of variation, skewness and curtosis.

4. Correlation, Regression: Linear correlation, coefficient of correlation: karlpearsons formula, spearman's rank method, curve fitting by the method of least squares: Fitting a straight line $y= a+bx$, Fitting a power curve $y= ax^b$, Fitting an exponential curve $y= ab^x$, $y= ae^{bx}$, Regression analysis for lines. 2

5. Definition of probability: Random experiment, sample space, Addition and multiplication laws of probability (without proof), probability distribution: binomial, poisson's, normal and chi-square, Student test and Pharmaceutical examples.

PART B: COMPUTER SCIENCE

1. **Introduction to computers:**

1. History and evolution of computers, digital and analogue computers, major components of digital computers, word length of a computer, microprocessor, single chip micro computers(micro controllers), large and small computers, user interface, hard ware, soft ware and firm ware. Operating systems. DOS, windows.Introduction to Linux, batch processing, multi

   programming and multi user system.Computer network:LAN, WAN, Parallel processing, Flinn's classification of computers.

2. Introduction to Programming :

   a. Definition of a programme, types of programming language : machine language, decimal number system, binary number or base 2 system, conversion of a binary number to decimal number, conversion of a decimal number to a binary number. Binary addition and sutraction, high level language, types of high level language.

3. Language: Basics of programming: Algorithm, flow chart:

   a. Introduction to C language: Development of C, Features, constants and variables, data types, operators and expressions, library functions.I/O statements: Formatted and unformatted I/O, scan ( ), print f ( ), getchar ( ) and put char ( ) function

   b. Control tructures: conditional and undconditional, if, for, while, switch, break and continue, goto statement. Arrays: one and multidimensional arrays, strings and string functions, bubble sort, linear and binary search. Functions: definition, different types, calling a function, passing parameters, call by reference, and call by value, local and global variables, recursive function

4. Computer graphics, computer application and clinical studies

II B.PHARM

2.1: PHYSICAL PHARMACEUTICS (Theory)

1. Physical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determination and applications.

2. pH, buffers and isotonic solutions: Sorensen's pH determinations (electrometric and calorimetric), applications, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, applications, buffered isotonic solutions.

3. Solubility phenomena: Solvent –solute interactions, solubility of gas in liquids, solubility of liquids in liquids (binary solutions, ideal solutions, Raoult's law, real solutions, distillation of binary mixtures, azeotropic mixtures and fractional distillation. Partially miscible liquids (conjugate mixtures), critical solution temperatures, applications, phenol-water system, triethylamine-water system, nicotine-water system. Solubility of solids in liquids: Definitions, determinations, factors influencing the solubility.

4. Distribution law: explanation, limitations and applications, effect of molecular association, dissociation and complexation.

5. Kinetics: Rates and molecularity of a reaction, determination of order, factors influencing rate of reactions, stabilization of drugs, applications of chemical kinetics to the stability testing of pharmaceuticals . Simple numerical problems.

6. Interfacial phenomenon: Liquid interfaces, adsorption at liquid/solid interfaces, adsorption isotherms, concept of contact angle, hydrophile lipophile balance, spreading coefficient, Gibb's adsorption equation, electrical properties of interfaces.

7. Diffusion and dissolution: Steady state diffusion, types of diffusion, diffusion equation, diffusion cells, Dissolution of tablets and capsules, Hixon-crowell cube root law. Dissolution apparatus; factors affecting dissolution.

1. Rheology: Newtonian and Non-newtonian systems, thixotropy, determinations of rheological properties (Single and multipoint instruments). Applications to pharmacy.

9. Micromeritics: Particle size distribution, methods for determining particle size, shape and surface area. Derived properties of powders. Simple numerical problems.

10. Coarse dispersions: Suspensions: Settling in Suspension, wetting, Controlled flocculation – flocculation in structured vehicles, Rheological consideration, preparation, physical stability and evaluation of suspensions. Emulsions: Definition, mechanism of action of emulsifying agents, theories of emulsification. Formulation of emulsions-instability of emulsions, evaluation of emulsion stability. Rheology of emulsions, microemulsions, multiple emulsions

11. Colloids: Definition types, preparation, purification, stabilization of colloids, properties, optical properties, kinetic properties, electrical properties. Donnan membrane phenomenon.

12. Complexation: Types of complexes, metal complexes, organic molecular complexes, inclusion compounds, methods of analysis of complexe.

II B.Pharm

2.2: PHARMACEUTICAL MICROBIOLOGY AND BIOTECHNOLOGY

(Theory)

1. Introduction to the science of microbiology. Major divisions of microbial world, and relationship among them.
2. Classification of microbes and study of bacteria, fungi, yeasts, actinomycetes, virus, rickettsia and spirochaetes. Study of mode of transmission and treatment of microbial diseases like, Cholera, Typhoid, Tuberculosis, Diphtheria, Tetanus, Syphilis and AIDS.
3. Nutritional requirements, growth and cultivation of bacteria and virus. Study of different important media required for the growth of aerobic and anaerobic bacteria and fungi. Differential media, enriched media and selective media, maintenance of laboratory cultures.

a. Different methods used in isolation and identification of bacteria with emphasis on different staining techniques and biochemical reactions. Counting of bacteria. Total and viable count. Bacteriological analysis of drinking water.

5. Detailed study of different methods of sterilization including their merits and demerits. Sterilization of equipments, validation of sterilization. Sterilization methods for all pharmaceutical products. Detailed study of sterility testing of different pharmaceutical preparations.
6. Disinfectants: study of disinfectants, antiseptics, fungicidal and virucidal agents. Factors affecting their activities and mechanism of action. Evaluation of bactericidal, bacteriostatic, virucidal activities, evaluation of preservatives in pharmaceutical preparations.
7. Introduction to genetics, Phenotypic and genotypic changes in bacteria, Mutations, genetic exchange in bacteria-transformation, transduction and conjugation.
8. Genetic Engineering: Study of vector, plasmids, transposons, cosmids, Restriction endonucleases and DNA ligases. Steps involved in recombinant DNA technology and its applications in the production of recombinant products like Insulin, Hepatitis B vaccine, Growth hormone and Interferon. Application of gel electrophoresis and southern blot techniques.

   Legislation and risks involved in the use of recombinant DNA products.
9. Immunology: Antigens, structure and formation of antibodies, antigen antibody reactions. Diagnostic tests such as Shick's test, Elisa test (HIV), Widal, Mantoux .and VDRL. Methods involved in production of Vaccines- Polio myelitis, BCG, Typhoid, Diphtheria and Tetanus toxoid and production of Sera- Diphtheria antitoxin.
10. Fermentation: Introduction to fermentation technology. Methods of production of Penicillin, Streptomycin, Riboflavin and Cyanocobalamine.
11. Principles and methods of different microbiological assays including sensitivity testing, microbiological assay of Cephelexin, Streptomycin and Vitamin B_{12}. Standardisation of vaccines and sera.

12. Animal tissue culture- techniques, nutritional requirements and characters of animal cell cultures. Hybridoma technology. Production and application of monoclonal antibodies.

II B.Pharm

2.3: PATHOPHYSIOLOGY (Theory)

1. Basic principles of cell injury and adaptation:
   i) Causes, pathogenesis and morphology of cell injury
   ii) Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen storage disease3

2. Inflammation:
   A) i) Pathogeneses of acute inflammation
      ii) Chemical mediators in inflammation.
      iii) Pathogenesis of chronic inflammation
   B) Repairs of wounds in the skin, Factors influencing healing of wounds.

3. Diseases of Immunity:
   i) Introduction to T and B cells
   ii) MHC proteins or transplantation antigens.
   iii) Immune Tolerance

   A) Hypersensitivity:
      i) Hypersensitivity type I.II.III, IV
      ii) Biological significance of hypersensitivity.
      iii)Allergy due to food, chemicals and drugs.

   B) Auto-immunity:
      i) Mechanism of Autoimmunity.
      ii) Classification of autoimmune diseases in man.
      iii)Transplantation and allograft reactions, mechanism of rejection of allograft.

   C) Acquired Immune Deficiency Syndrome (AIDS)

   D) Amylodosis

4. Cancer:
   Disturbances of growth of cells, General biology of tumors,
   Differences between benign and malignant tumors
   Classification of tumors
   Histological diagnosis of malignancy
   Etiology and pathogenesis of cancer
   Invasions, metastasis, patterns of spread of cancer.

5. Shock: Types, mechanism, stages and Management

6. **Biological effects of radiation:**
7. **Environment and Nutritional diseases:**
   i) **Air pollution and smoking – SO_2, NO, NO_2, CO**
   ii) **Protein calorie malnutrition, vitamins, obesity, starvation.**

8. Pathophysiology of common diseases:
   I) Parkinsonism
   ii) Schizophrenia
   iii) Depression and Mania
   iv) Stoke (Ischemic and Hemorrhage)
   v) Hypertension
   vi) Angina
   vii) Myocardial Infarction
   viii)CCF
   ix) Atherosclerosis
   x) Diabetes Mellitus
   xi) Peptic ulcer and inflammatory bowel disease
   xii) Cirrhosis and Alcoholic liver diseases
   xiii) Acute and chronic renal failure
   xiv) Asthma and chronic obstructive airway diseases

9. Infectious diseases
   Hepatitis – infective hepatitis,
   Sexually transmitted diseases (Syphilis, Gonorrhea, HIV)
   Pneumonia, Typhoid, Urinary tract infections, Tuberculosis, Leprosy, Malaria, Dysentery (Bacterial and amoebic)

II B.Pharm
2.4: APPLIED BIOCHEMISTRY (Theory)

1. Bio chemical organization of the cell and transport processes across cell membranes.

2. Bio energetics
   a) Concept of free energy and its determination; redox potential;
   b) Energy rich compounds; ATP; Cyclic AMP; their biological significance

3. Biological Oxidation
   a) Electron transport chain (its mechanism and role)
   b) Inhibitors and Uncouplers of ETC
   c) Oxidative phosphorylation
   d) Substrate level phosphorylation and oxidative phosphorylation

4. Enzymes and Coenzymes
   a) Definition ; Nomenclature ; IUB Classification
   b) Properties of enzymes;
   c) Factors effecting enzyme activity;
   d) Enzyme kinetics (Michaelis plot ; Line Weaver Burke plot)
   e) Enzyme Inhibition (with examples)
   f) Iso-enzymes
   g) Enzyme Induction; repression
   h) Applications of enzymes
   i) **Coenzymes, categories of reactions requiring coenzymes;**
   b. Structure of, its coenzyme, and biochemical role of
   c. Vitamins - water soluble, fat soluble

5. Carbohydrate metabolism
   a) Introduction
   b) Glycolysis,
   c) Glycogensis glycogenolysis,
   d) TCA cycle; (Amphibolic nature of TCA cycle)
   e) Gluconeogensis
   f) Various shuttle systems (glycerol phosphate; Malate aspartate)
   g) HMP Shunt Pathway;
   h) Uronic acid pathway and galactose metabolism
   i) Glucose tolerance test and blood glucose regulation.

6. Lipid metabolism
   a) Introduction
   b) -Oxidation of saturated (palmitic acid) fatty acids
   c) -Oxidation of unsaturated fatty acids (-linolenic acid)
   d) Formation and fate of ketone bodies
   e) Cholesterol metabolism,
   f) Biosynthesis of fatty acids (de novo)
   g) Phospholipids and sphingolipids.

7. Amino acid metabolism
   a) Amino acids definition, classification and significance
   b) General reactions of amino acids: Transamination, Deamination and decarboxylations of amino acids
   c) Urea cycle
   d) Metabolism of sulphur containing amino acids
   e) Catabolism of tyrosine, tryptophan, phenylalanine
   f) Synthesis & significance of biologically important substances: creatine, histamine, 5-HT, dopamine, noradrenaline, adrenaline.
   g) Porphyrins, Bile Pigments; Hyperbilirubinemia

8. Nucleotides and Nucleic acids
   a) Introduction
   b) Purine nucleotides biosynthesis
   c) Pyrimidine nucleotides biosynthesis
   d) Catabolism of purines and pyrimidines
   e) DNA structure, significance as genetic material
   f) RNA types, structure and significance
   g) DNA replication
   h) Mutation and repair of DNA
   i) Transcription or RNA synthesis
   j) Genetic code
   k) Translation or protein synthesis and its Inhibition

9. Principles and significance for following Biochemical tests
   a) Kidney function tests
   b) Liver function tests
   c) Lipid profile

II B.Pharm
2.5: PHARMACEUTICAL ORGANIC CHEMISTRY-II (Theory)

The subject is to be treated in the light of modern perspective giving stress wherever possible on the following aspects-structure, nomenclature, preparation, properties, energy of activation, transition state, resonance, stereochemistry, optical isomerism, Geometric isomerism and mechanism of reaction.

I. Stereochemistry:

1. Stereo isomerism, tetrahedral optical activity, enantiomerism, diastereoisomerism, meso structures, elements of symmetry, chirality, chiral centers, reaction of chiral molecules, configuration, specification of D and L configuration. Nature of E and Z forms. Recemic modification and resolution of recemic mixture, conformational isomers, asymmetric
   synthesis.

2. Stereo selective and steriospecific reactions. Stereochemical mechanisms for the following reaction such as addition of halogen to alkenes, E^1 and E^2 reactions, syn and anti reactions, and nucleophilic substitution reactions.

3. Geometrical isomerism, its nature of formation, rotation about bonds: nomenclature of isomers, determination of configuration.

4.Stereochemistry of alicylic compounds and biphenyls, stereochemistry of oximes.

II. Heterocyclic Chemistry:

1. General classification of heterocyclic compounds, nature and nomenclature. reactions, synthesis and properties of the following heterocyclic systems and their derivatives.

   a) Pyrrole, Furan and Thiophene
   b) Fused ring systems involving Pyrrole, Furan, Thiophene, Indole and Benzofuran
   c) Pyridine
   d) Quinoline, Isoquinoline, acridine
   e) Pyrazole, Imidazole, Oxazole, Isoxazole
   f) Pyrimidine,Pyrazine,Pyridazine,Purine,benzodiazepines

2. Study of basic structures, compounds having pharmacological activity/medicinal compounds of tricyclic hetero ring systems-phenothiazines, and benzodiazepines.

3. Structure and medicinal uses of the following official compounds
   1. Phenazone 2.Nicotinicacid 3.Nikethamide 4.Isoniazid 5.Mepyramine 6.Benzhexol 7.Chloroquine 8.Histamine 9.Carbimazole.10.Pyreimethamine 11.Piperazine. 12.Diazepam
   13.Diethylcarbamazine citrate 14.Sulphadiazine 15. Metronidazole.

III Poly Nuclear Hydrocarbons; Synthesis (Haworth's and Diel's Alder) properties and reactions of Naphthalene, Phenanthrene and Anthracene. Structure and medicinal uses of Propranolol, Tolnaftate, Menadione, Naphzoline, , Phenindione, Morphine and Codeine.

IV Chemistry of bio molecules of pharmaceutical importance:

1. **Carbohydrates:**
Introduction, Definition, Classification, Nomenclature, Structural determination of Glucose and Fructose. Stereoisomers of monosaccharides, reactions, conversions, configuration, cyclic structures of glucose, determination of ring size in Glucose. Fischer projection formulae, and conformations. Disaccharides and polysaccharides. Chemical nature of maltose, lactose, sucrose, starch and cellulose, derivatives used in pharmacy.

1. **Fats and Oils:**
Chemistry of fats oils and waxes. Occurrence and composition. Hydrolysis of fats, esterification. Fats as sources of pure acids and alcohols. Analytical constants of fats and oils. Methods of their determination and significance. Unsaturated fats, hardening of oils, hydrogenation of oils, drying, semidrying and nondrying oils.

3. **Proteins and Amino acids:**
Introduction, definition, classification of proteins and amino acids and their properties, reactions, synthesis of amino acids (Gabriel's Pthalimide, synthesis, Strecker's synthesis, Koop's and Erlenmeyer's azalactone synthesis). Peptide linkages, structures of proteins, C-terminal and terminal analysis. Isoelectric points and its significance.

III B. Pharm
3.1: MEDICINAL CHEMISTRY I (Theory)

I. **Basic Principles of Medicinal Chemistry**

A. A brief introduction to the subject, history and development of medicinal Chemistry, definition and fundamental principles of drug therapy.

B. Effects of the following physicochemical properities of drug molecules on biological activity: Solubility, partition coefficient, hydrogen bonding, protein binding, chelation, Geometrical and optical isomers, redox potential, ionization and surface activity.

C. Principles of drug design (theoretical aspects): General principles of drug action and drug receptor interactions.

D. Drug metabolism: General pathways of drug metabolism, sites of drug biotransformation, role of cytochrome P-450 and monoaminooxygenase in oxidative biotransformations. Oxidative, reductive, hydrolytic and conjugation reactions. Factors affecting drug metabolism.

A study of the development of the following classes of drugs including structure activity relationships (SAR), mechanisms of action, synthesis of compounds underlined and superscribed by 's', chemical nomenclature, generic names, brand names (a few important marketed products and side effects).

II. Central nervous system depressants

A. General anaesthetics:

1. Inhalation anaesthetics: Halothanes, Methoxy flurane, Nitrous oxide.
2. Ultra short acting barbiturates: Methohexital sodiums, Thiopental sodium,
3. Dissociative anaesthetics : Ketamine hydrochloride.

B. Anxiolytic, sedative and hypnotic agents:

1. SAR of Benzodiazpine Chlordiazepoxides, Diazepams, Oxazepam, Chlorazepam, Lorazepam, Flurazepam, Alprazolam.

2. SAR of Barbiturates:
a) Barbitals, methabarbital, Phenobarbitals,
b) Amobarbitals, Butabarbital,
c) Pentobarbitals, Secobarbital

3. Miscellaneous sedative hypnotics:
a) Amides and Imides: Glutethmide[s], Methyprylon, Methaqualone.
b) Alcohols and their carbamate derivatives: Ethclorvynol, Ethinamate, Meprobomate[s].
c) Aldehydes and their derivatives: Chloral hydrate[s], Paraldehyde.

C. Skeletal muscle relaxants: Chlorphensin[s], Methocarbamol.

D. Drugs used in spasticity: Baclofen, Buspirone.

E. Anticonvulsants:
1. Mechanism of anticonvulsant action.
2. Barbiturates: Phenobarbitone.
3. Hydantoins : Phenyton sodium, Ethtoin, Mephyntoin
4. Oxazolidine diones: Triemethadione[s], Paramethadione
5. Succinimides: Phensuximides, Methsuximide[s], Ethosuximide.
6. Urea and monoacylureas: Phenacetamide[s], Carbamazepine[s].
7. Miscellaneous: Primidone[s], Valproic acid.
8. Benzodiazepines: Clonazepam[s], Diazepam, Chlorazepam.

III. Adrenergic agents :

A. Adrenergic neuro transmitters: function, structure and physicochemical Properties, biosynthesis and metabolism of noradrenaline.

B. Adrenergic receptors: alpha and beta-adrenergic receptors, their distribution in the human body.

C. Sympathomimetic agents:
1. Direct acting agents; Definition and examples: Phenylethylamine, Noradrenaline
2. Indirect acting agents: Definition and examples: Isoproteneol[S], Terbutalin.
3. Agents with mixed mechanism: Examples: Clonidine[S],
4. Alpha adrenergic receptor agonists: Examples: Ergotamine.
5. Beta adrenergic receptor agonists: examples: Pseudoephidrine.
6. Aliphatic amines: Triaminoheptane, Cyclopentamine[S],
7. Imidazoline derivatives: Naphazoline [S], Tetrahydrozoline, Oxymetazoline, Xylometaxazoline.

D. Adrenergic blocking agents
1. Neuronal blocking agents: Alpha-adrenergic blocking agents-ergot alkaloids.
2. Beta halo alkyl amines: Dibenzamine, Phenoxybenzamine[S]
3. Imidazolines: Tolazoline, Phentolamine[S], Prazocin.
4. Beta adrenegic blocking agents: Propranolol[S], 4-hydroxy propranolol, practolol, Metaprolol.

IV. Cholinergic drugs and related agents.

A. Cholinergic agents:

1. Cholinergic neurotransmitter: function, structure, physiochemical properties, biosynthesis and metabolism of Actylcholine.
Cholinergic receptors: muscarnic and nicotinic receptor, their distribution in the human body

2. Indirectly acting cholinergic agonists:
a) Cholinestrase inhibitors: Physostigmine[S], Neostigmine. Pyridostigmine[S].
b) Irreversible inhibitors: Malathion, Parathion.

B. Cholinergic blocking agents: Parasypathetic postganglionic blocking Agents: Atropine, Hyoscyamine, Scopolamine, Homatropine, Methscopolamine.

C. Synthetic Cholinergic blocking agents: Clidinium bromide, Dicyclomine[S], Propantheline, Benzotropine Chlorphenoxamine,

D. Ganglionic blocking agents: Trimethaphan camsylate, Mecamylamine.

E. Neuromuscular blocking agents: d-Tubocurarine chloride, Metocurine iodide. Synthetic compounds with curare form activity–Decamethonium bromide.

V. Local anaesthetics

A. Historical development, mechanism of action of local anaesthetics.
B. SAR of – Benzoic acid derivatives, Lidocaine derivatives.
C. 1. Benzoic acid derivatives: Hexylcaine, cyclomethycaine, Piperocaine[S].
2. Amino benzoic acid derivatives: Benzocaine[S], Procaine[S], Procainamide.
3. Lidocaine derivatives (Anilides): Lidocaine[S], Prilocaine,
4. Miscellaneous: Dimethisoquin, Dibucaine[S].

VI. Histamines and anti histaminic agents

A. Histamine, receptors and their distribution in the human body
B. Antihistaminic agents: H_1 antagonists.
1. Amino alkyl ethers: Diphenhydramine hydrochloride[S], Bromodiphenhydramine, Doxylamine.
2. Ethylene diamines: Tripelennamine[S], Pyrilamine.

3. Propylamine derivatives: Pheniramine[5], Chlorpheniramine.
4. Phenothiazine derivatives: Promethazine[5], Trimeprazine.
5. Piperazine derivatives: Cyclizine, Meclizine[5].
6. Miscellaneous compounds: Phenindamine, Cyproheptidine.

C. H_2- Antogonists: Mechanism of H_2-Antogonists
Cemetidine[5], Ranitidine.
Gastric proton pump inhibitor- an introduction
Omeprazole.

VII. Analgesic Agents

A) Structure and uses of morphine, codeine and diacetyl morphine.
B) Narcotic Antagonists: Structure and uses of Nalorphine, Levalorphan.
C) Antitussive agents: Structure and uses of Noscapine, Dextromethorphan
D) Peripheral and Nuclear modification of Morphine.
E) Anti-Inflammatory agents
   1. Salicylic derivaties: Sodium Salicylate
   2. N-aryl anthranilic acid derivatives: Mefenamic acid[5], Diclofenac sodium.
   3. Aryl Acetic acid derivatives: Indomethacin, Ibuprofen[5], Piroxicam[5].
   4. Aniline and P-aminophenol derivatives: Phenacetin[5] Acetaminophen[5].
   5. Pyrazolone and Pyrazolidinedione derivatives: Antipyrin, Aminopyrin, Oxyphenbutazone[5], Phenylbutazone.

VIII. Prostaglandins and other Eicosanoids

A. History and discovery
B. Eicosanoid biosynthesis
C. Drug action mediated by Eicosonoids.
D. Design of Eicosanoid drugs.
E. Eicosanoid approved for human clinical use.
F. Prostaglandins F2 , Prostaglandin E2, 15-(s)-methyl-PG
F2 Prostaglandin E1, 16-(R, S) methyl–16–hydroxy –methyl ester.

III B. Pharm

3.2: PHARMACEUTICAL JURISPRUDENCE AND ETHICS (Theory)

1. Introduction
   a. Pharmaceutical legislations - brief review.
   b. Drugs and pharmaceutical industry – a brief review.

2. An elaborate (practical oriented) study of the following
   a. Pharmaceutical ethics
   b. Pharmacy Act 1948 3
   c. Drugs and Cosmetics Act 1940 and rules 1945 (with special reference to schedule M, P, U, V and Y)
   d. Medicinal and Toilet Preparations (Excise Duties) Act 1955
   e. Narcotic Drugs and Psychotropic Substances Act 1985 and rules
   f. Drugs Price Control Order, Pharmaceutical Policy 2002

3. A brief study of the following with special reference to the main provisions
   a. Drugs and Magic Remedies (Objectionable Advertisements) Act 1954

b. Prevention of Cruelty to Animals Act 1960 including study of CPSCEA guidelines, INSA & ICMR guidelines

c. Indian Patents Act with special reference to pharmaceuticals along with amendment bills, process patent and product patent

4. A brief study of the various prescription/non-prescription products, Medical/surgical accessories, diagnostic aids, appliances available in the market.

III B.Pharm
3.3: PHARMACOGNOSY AND PHYTOCHEMISTRY (Theory)

1. Isolation, purification and estimation of phytoconstituents:
   a) General methods used for the isolation and purification of natural products including superfluid critical extraction.
   b) General methods of identification & estimation of phytoconstituents.
   c) Detailed study of chromatographic techniques for separation, isolation & identification of phytoconstituents.
   d) Evaluation of natural products - Morphological, Physical, Microscopical, Chemical, Spectroscopical and Biological methods.

2. Biogenesis of phytopharmaceuticals:
   a) Techniques employed in the elucidation of biosynthetic pathways.
   b) Brief study of basic metabolic pathways
   c) Biosynthesis of - Tropane, Quinoline, Opium and Indole alkaloids, Steroids and Anthraquinone glycosides.

3. Glycosides:
   a) Definition, general characters and classification.
   b) Definition, general properties, chemical nature, general methods of isolation, estimation and uses of the followings:
   i) Cardiac glycosides ii) Anthracene glyosides iii) Saponins
   iv) Cyanogenetic glycosides v) Flavonoids vi) Lactones and bitter glycosides
   vii) Isothiocyanate glycosides.
   c) Sources, diagnostic characters, constituents, uses and adulterants of
   (i) Digitalis (ii) Strophanthus (iii) Squill (iv) Senna (v) Rhubarb
   (vi) Cascara (vii) Aloes (viii) Ginseng (ix) Liquorice (x) Solanum species
   (xi) Wild Cherry (xii) Bitter almond (xiii) Quassia (xiv) Dioscorea
   (xv) Citrus bioflavanoids (Lemon and Orange peel) (xvi) Mustard.

4. Alkaloids:
   a) Definition, general properties, chemical tests, general methods of isolation and estimation of alkaloids.
   b) Sources, diagnostic characters, constituents, uses and adulterants of:
   (i) Lobelia (ii) Solanaceous drugs (iii) Cinchona (iv) Ipecac
   (v) Opium (vi) Rauwolfia (vii) Ergot (viii) Nux-vomica (ix) Vinca
   (x) Taxus species (xi) Aconite (xii) Kurchi (xiii) Ephedra (xiv) Colchicum

5. Essential Oils:
   a) Introduction, definition, general properties, chemical nature, and classification.
   b) Source, diagnostic characters, chemical constituents and uses of:
   (i)Clove (ii) Cinnamon (iii) Coriander (iv) Fennel (v) Eucalyptus
   (vi) Mentha piperita (vii) Sandal wood.
   c) Methods of production and analysis of -Clove, Cinnamon, Eucalyptus, Mentha and Sandal wood oils.

6. Resins:
   a) Study of properties, classification and method of production
   b) Sources, diagnostic characters, active constituents, uses and adulterants of : (ii) Cannabis (ii) Podophyllum (iii) Ginger (iv) Capsicum (v) Benzoin (vi) Asafoetida (vii) Colophony.
7. Tannins:
   a) Definition, properties, classification, general method of isolation, estimation and uses of tannins.
   b) Source, chemical constituents, tests and adulterants of (i) Catechu (ii) Tannic Acid (iii) Nutgall

III B.Pharm
3.4: PHARMACEUTICAL ENGINEERING (Theory)

1. Stoichiometry: Unit Processes, material and energy balances, units and their conversions Dimensional formulae, dimensionless numbers.
2. Fluid flow:
   a) Fluid statics: hydrostatic pressure, definition of heads, manometers,
   b) Fluid dynamics: mechanism of fluid flow, Reynolds's experiment, Bernoulli's theorem and its applications, Flow meters-, orifice meter, venturimeter, pitot tube and rotameter
3. Heat transfer: Concept of heat flow by conduction through single wall, applications of Fourier's law, Forced and natural convection, surface coefficients, Boiling liquids, Condensing vapors, Temperature gradients in parallel and counter current heat exchangers. Heat interchangers, Radiation, black body, Stefan-Boltzmann equation, Kirchoff's law.
4. Evaporation: Basic concept of phase equilibria, factors affecting evaporation. Evaporators, - film evaporators, single effect and multiple effect evaporators, theory and economy.
5. Distillation: Raoult's law, Volatility, simple, steam and flash distillations. Principles of rectification, azeotropic , molecular and extractive distillation.
6. Drying: Moisture content and mechanism of drying, factors affecting drying. Classification and types of dryers, dryers used in pharmaceutical industries. Construction and working of tray dryer, fluidized bed dryer, drum dryer, vacuum Dryer, Freeze dryer and Spray dryer.
7. Size reduction: Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mill, types of mills, construction and working of ball mill, hammer mill, fluid energy mill, Edge runner and end runner mill.
8. Size separation: Different techniques of size separation- sieves, sieve shakers, sedimentation tanks, Mechanical classifiers, Cyclone separators, Air separators, Bag Filter.
9. Mixing: Theory of mixing, solid-solid, solid-liquid and liquid – liquid mixing. Equipments-tumbler, V-cone, double cone, ribbon blenders, Sigma blade and planetary, zig-zag mixers. Mixing devices, - Propellers, turbines, paddles, and baffles. Vortex formation and prevention.

Homogenisation, and homogenisers

10. Material handling system: Construction and working of a belt conveyor screw conveyor, pneumatic conveyor, cycloidal blowers and chain conveyers.

11. Filtration and Centrifugation: Theory of filtration and Kozeny's equation, classification of industrial filters, Construction and working of filter press, filter leaf, meta filter, candle filter. Filter aids. Theory and principle of centrifugation, classification of industrial centrifuges. Centrifuges, - basket, tubular bowl, conical disc, semi continuous, and continuous horizontal centrifuges.

12. Crystallization: Crystal habits, solubility curves, Mier's theory, construction and working of agitated batch crystalliser, Swenson-walker, Krystal and Vacuum crystallisers. Caking of crystals.

13. Humidification, Airconditioning and Refrigeration: Definition of humidity, humid heat, humid volume, study of psychrometric charts, wet bulb theory, theory of air conditioning and air conditioner. Refrigerator-, single stage refrigeration, Molliers diagram, coefficient of performance, and their application to pharmacy.

14. Materials of construction: Iron, Steel, lead, glass, aluminum, rubber and plastic as construction materials.

15. Corrosion: Classification and mechanism of corrosion, Factors, Prevention and control.

16. Plant location: Layout, utilities and services. Industrial hazards and safety measures.

III B.Pharm

3.5: PHARMACOLOGY I (Theory)

1. General Pharmacology
   a) Introduction and definitions- Sources and active ingredients of drugs.
   b) Routes of administration of drugs.
   c) Absorption of drug and the factors affecting them.
   d) Drug Distribution, Bio-transformation and Excretion
   e) Mechanism of drug action – Drug-Receptor interactions and molecular & biochemical basis of drug action. Additive effect, synergism, potentiation.
   f) Factors modifying drug effects.
   g) Drug toxicity
   h) Dose response relationship, structure activity relationship
   i) Drug interactions: Basic concepts of Drug interactions (Both in vitro & in vivo)
   j) **Pre-clinical & clinical evaluations.**

Note : **The term Pharmacology used here refers to the classification, mechanism of action, Pharmacokinetics, pharmacodynamics, adverse effects, contraindications, therapeutic uses and dosage.**

2. Pharmacology of drugs acting on Autonomic Nervous System
   a) Introduction – Neurohumoral Transmission
   b) Adrenergic and Cholinergic receptors
   c) Adreneric drugs.
   d) Adrenergic receptor blockers, adrenergic neuron blockers.
   e) Cholinomimetics, Anticholinesterases.
   f) Antimuscarinic agents
   g) Ganglionic blockers and stimulants
   h) Neuromuscular blocking agents
   i) Drugs used in parkinsonism and myasthenia gravis.

   Definition: Health, Drug, Pharmacology, Pharmacokinetics and Pharmacodynamics.

3. Pharmacology of Drug acting on Cardiovascular System
   a) Anti- hypertensives.
   b) Anti-anginal drugs
   c) Anti-arrhythmic drugs.
   d) Drugs used for therapy of congestive cardiac failure
   e) Drugs used in hyperlipidaemias

4. Pharmacology of Drugs Acting on Central Nervous System
   a) General consideration (Introduction)
   b) Alcohol
   c) General anaesthetics
   d) Sedatives and hypnotics
   e) Anti-convulsants
   f) Narcotic analgesics
   g) Non-steroidal anti inflammatory agents and Analgesics
   h) Psychopharmacological agents: Antipsychotics, Antidepressants, Anxiolytics
   i) Drug dependence and drug abuse

2. Pharmacology of Local anaesthetics

3. Pharmacology of Drugs Acting on Blood and Blood forming Agents
   a) Coagulants and anti-coagulants.
   b) Haemopoietics.
   c) Thrombolytics and antiplatelet agents.

4. Pharmacology of Drugs Acting on Renal System (Diuretics) and antidiuretics.

IV B.Pharm

4.1: PHARMACEUTICAL TECHNOLOGY AND BIOPHARMACEUTICS

(Theory)

1. Tablets:
   a. Formulation of different types of tablets, granulation technique, equipment employed. In process, evaluation of tablets and packaging.
   b. Tablet coating: Types of coating, coating materials, formulation of coating solution, methods of coating and equipment employed, quality control tests of coated tablets.
2. Capsules:
   a. Hard gelatin capsules: Extraction of gelatin, production and filling of hard gelatin capsules, finishing and special techniques, quality control tests for capsule.
   b. Soft gelatin capsules: Nature of shell and capsule content, importance of base adsorption and minim / gram factors, production, in process and final product quality control tests.
3. Parenteral Preparation: Definition, types, advantages and limitation, general formulation, vehicles, production procedure, production facilities and controls. Formulation of injections, sterile powders, implants and long acting parenterals, emulsions and suspensions. Containers and closures pertinent to sterile preparations and Pharmacopoeial quality control tests.
4. Ophthalmic formulations: Requirements, formulation of eye drops, eye lotions and eye ointments, containers and evaluation.
5. Liquid orals: Formulation of solutions, manufacturing, filling and packaging.
6. Semisolid dosage forms: Definition, types, semisolid bases, their selection. Formulation of semsolids such as ointments, gels, jellies, suppositories, packaging, and their evaluation.
7. Pharmaceutical aerosols: Definition, propellants, containers, valves, types of aerosol systems, manufacture of aerosols, quality control and stability studies.
8. Radiopharmaceutical: Uses in diagnosis and treatment, methods of preparation handling and safety precaution.
9. Cosmetics: Formulation and preparation of the following cosmetic preparations. Lipsticks, Shampoos, Face and talcum powders, Nail lacquers, cold cream and vanishing cream and toothpastes, hair dyes.
10. Biopharmaceuitcs: Definition and applications, passage of drugs across the biological barriers (passive diffusion, active transport, facilitated, pinocytosis) factors influencing absorption-Physiological, physicochemical, and pharmaceutical, blood level curves for I.V, constant rate infusion, oral, I.M., and sustained release dosage forms. Bioavailability, measurement of Bioavailability (^{C}max, ^{T}max, AUC). Definition of Bio equivalence

IV B.Pharm
4.2: INSTRUMENTAL AND BIOMEDICAL ANALYSIS (Theory)

The subject to be discussed with special reference to quality control and assurance of pharmaceuticals, its scope and its importance in the pharmaceutical industry. The following analytical techniques should be discussed with suitable examples.

1. Absorption spectroscopy: Theory of electronic, atomic and molecular spectra, Beer and Lambert's law, Derivation and Deviations, Application of Beer's law to single component analysis and multicomponent systems, Chromophores, Auxochromes, Bathochromic shift, hypsochromic shift, Hyperchromic and hypochromic effects, Effect of solvent on absorption spectra.

   UV/Visible spectroscopy: Instrumentation and working; Sources of radiation, Wavelength selectors; Filters- Prisms and Gratings, Sample cells, Detectors- Phototube, Photomultiplier tube, Barrier layer cell and Silicon photo diode.

   IR Spectroscopy: Instrumentation, Working and Sample handling methods, Sources of radiation, Monochromators, Sample cells and detectors- Bolometers, Thermocouples, Golay cells.

   Applications: Measurement of equilibirium constant and rate constant by spectroscopy, spectrophotometric titrations, IR Frequency - structure correlation, study of characteristic fundamental stretching vibrations of functional groups like Alcohol, Carboxyl, Amide esters, Amine, Aldehyde, Ketone and Phenol.

2. Fluorimetric analysis: Theory, concept of singlet and triplet electronic states, Internal and external conversions, intersystem crossing, factors affecting fluorescence, Quenching.
   Instrumentation- Study of Fluorimeter, Spectrofluorimeter and Applications

3. Flame emission and atomic absorption spectrometry: Theory, Nebulization, flames and flame temperatures, interferences, flame spectrometric techniques.
4. Nephelometry and Turbidimetric Analysis: Theory, General principles, Instrumentation and applications.

5. Chromatography : Introduction and classification,

   A) Column chromatography: Adsorption column chromatorgraphy, develpoment Techniques – Frontalanalysis, Displacement analysis and elution analysis. Factors affecting column efficiency. Applications, Partition Chromatography.

B) Thin layer chromatography: Introduction, principle, technique, Rf values and applications. 1

C) Paper Chromatography: Introduction, Principle, Technique, Development, methods and applications.

D) Ion exchange chromatography: Ion exchange materials, synthetic ion exchange resins, Properties of ion exchangers; mechanism of ion exchange process, factors affecting ion exchange, applications.

E) Gas chromatography: Introduction, theory, instrumentation-carrier gas, types of columns, stationary phases in gas liquid chromatography and gas solid chromatography. Detectors-Flame ionization detector, electron capture detector, thermal conductivity detector. Gas chromatogram, Derivatisation techniques like silylation, and esterification, Programmed temperature gas chromatography, Applications.

F) HPLC: Introduction, theory, instrumentation –Solvent treatment systems, Pumps-Reciprocating and displacement pumps, Columns, Detectors- UV detectors, Flourimetric detectors, Refractive index detectors and applications.

G) Electrophoresis: Principles of separation, equipment for paper and gel electrophoresis, Moving boundary electrophoresis, Applications.

6. Electrometric methods:

A) Potentiometry: Electrochemical cell, construction and working of reference electrode, Normal hydrogen electrode, calomel electrode, silver-silver chloride electrode, Indicator electrodes- Glass electrode, Antimony electrode, Quinhydrone electrode, Potentiometric titrations, methods of detecting end point.

B) Conductometry: Introduction, conductivity cell, conductometric titrations, Applications. 2

4. Quality assurance: Introduction, Sources of quality variation, control of quality variation, Validation methods.

IV B.Pharm

4.3: PHARMACOLOGY & TOXICOLOGY II (Theory)

1. Pharmacology of Autacoids and their Antagonists
Histamine and antihistaminics
5-Hydroxytryptamine and its antagonists
Lipid derived autacoids and platelet activating factor

2. **Pharmacology of Drugs Acting on Respiratory Tract**
Bronchdilators, Mucolytics, Expectorants, Antitussives, Nasal decongestants.

3. Pharmacology of Drugs Acting on Gastro Intestinal Tract
   Antiulcer drugs, Antacids
   Laxatives and Purgatives
   Emetics and Antiemetics
   Appetizers, Digestants, Carminatives

4. Pharmacology of Hormones and Hormone Antagonists
   Thyroid and antithyroid drugs.
   Insulin, Insulin analogues and oral hypoglycemic agents
   Sex hormones and oral contraceptives
   Oxytocin and other uterine stimulants and relaxants

5. Chemotherapy
   a) Introduction
   b) Sulfonamides and Co-trimoxazole
   c) Penicillins and Cephalosporins
   d) Tetracyclins nd Chloramphenicol
   e) Macrolides Aminoglycosides, Polyene & Polypeptide antibiotics.
   f) Quinolones and Fluoroquinolones
   g) Antifungal antibiotics
   h) Antiviral agents
   i) Chemotherapy of Tuberculosis and Leprosy
   j) Chemotherapy of Malaria
   k) Chemotherapy of Protozoal infections (amoebiasis, Giardiasis)
   l) Pharmacology of Anthelmintic drugs
   m) Chemotheapy of Cancer (Neoplasms)

6. Bio Assays
   Scope, Principles involved and General methods.

7. Immunopharmacology
   Pharmacology of immunosuppressants and stimulants

1. Principles of Toxicology
   a) Acute, Subacute & Chronic toxicity
   b) General principles of treatment of acute toxicity and acute poisoning .
   c) Signs, Symptoms and treatment of acute and chronic poisoning due to.
   i) Barbiturates ii) Alcohols iii) Benzodiazepines iv) Antidepressants
   v) Neuroleptics vi) Insecticides vii) Snake bite viii) Heavy metals (iron, lead, mercury, arsenic).

2. Definitions of Drug-Drug, Drug-food interactions classification of Drug-Drug interaction. Basic concepts of mechanisms of drug – drug interactions.

IV B.Pharm
4.4: MEDICINAL CHEMISTRY II (Theory)

A. Modern concepts of rational drug design: A brief introduction to quantitativ structure activity relationship (QSAR), Prodrug, combinatorial chemistry and computer aided drug design.
(CADD)

B. History and development of chemotherapeutic agents: Structure, uses and synthesis of only those compounds that are underlined and superscribed by 's'.

C. Anti-infective agents:

1. Local anti-infective agents:

a) Alcohols and related compounds: Alcohol, isopropyl alcohol, formaldehyde solution.

b) Phenols and their derivatives: p-Chloro phenol, hexachlorophene, Resorcinol, hexyl resorcinol.

c) Oxidizing agents: Hydrogen peroxide solution, hydrous benzoyl peroxide.

d) Halogen containing compounds: Iodine Tincture, Chlorine containing compounds halozone.

e) Cationic surfactants: Benzalkonium chloride, cetylpyridinium chloride.

f) Dyes-Gentian Violet, Methylene blue.

g) Nitrogen compounds: Nitrofurazone, Furazolidone[s].

2. Preservatives:

a) Para hydroxy benzoic acid derivatives: Methylparaben, Propyl paraben, Ethyl paraben.

b) Miscellaneous: Chlorobutanol, Benzyl alcohol, Phenylethyl alcohol, Sodium benzoate, Phenyl mercuric nitrate, Phenyl mercuric acetate.

3. Antifungal agents:

a) Antifungal antibiotics- Nystatin, Candicidin, Hamycin, Griseofulvin Ampoterecin-B Synthetic anti fungal agents:

b) Substituted imidazoles: Clotrimazole, Miconozole, Ketoconazole.

c) Miscellaneous–Zinc propionate, Sodium caprylate, Tolnaftate[s].

4. Urinary tract anti-infectives:

a) Quinalones: Nalidixic acid, Cinoxacin, Norfloxacin,Ciprofloxacin[s],Pefloxacin Ofloxacin. Sparfloxacin

b) Miscellaneous: Nitrofurantoin[s].

5. Antitubercular drugs: SAR of antitubercular drugs,

a) Synthetic antitubercular agents: p-Aminosalysilic acid[s], Isoniazid[s], Ethambutol[s], Pyrazinamide, Ethionamide, Clofazamine.

b) Antitubercular Antibiotics: Cycloserine, Viomycin sulfate, Capreomycin sulfate, Rifampicin.

6. Anti Viral Agents.

a) Amantidine hydrochloride, Iodoxuridine, Acyclovir, Zidovidine.

b) Anti-AIDS: Aza thymidine, Suramin

7. Antiprotozoal agents: Emetine hydrochloride, Metronidazole[s], Diloxanide furoate[s], 8-hydroxy quinoline derivatives(clioquinal[s], iodoquinal). Carbarsone.

8. Anthelmintics: Piperazine, Diethyl carbamazine[s], Pyrantel pamoate, Thiabendazole[s], Mebendazole,

D. Sulfonamides, Sulfones as antibacterial agents :

1. SAR of Sulfonamides.

2. **Classification of sulfonamides based on duration of action and site of action with examples. Sulfamethiazole, Sulfisoxazole[s], Sulfapyridine, Sulfamethoxazole[s], Sulfadiazine, Sulfacetamide, sulfasalazine, Phthalyl sulfathiazole.**

3. Folate reductase inhibitors: Trimethoprim[$], Synergistic action of the combination of sulfamethoxazole and trimethoprim.

4. Sulfone: Dapsone[$].

E. Antimalarials: Etiology of malaria, History, Mechanism and SAR

1. Quinolines and analogues
   7-chloro-4-amino quinolines : Chloroquine phosphate[$], Hydroxy Chloroquine sulphate, Amodiaquine. 8-amino quinolines: Pamaquine Primaquine[$], 9-amino acridines: Quinacrine[$]

2. Miscellaneous: Mefloquine, Pyrimethamine[$], Trimethoprim.

3. Biguanides and Dihydrothiazines: Chloroguanide, Cycloguanil.

F. Antibiotics: Historical background, Mechanism of action, classification-

1. Beta lactam antibiotics: Pencillins – structures, chemical degradation, bacterial resistance. Penicillin G, Penicillin V, Cloxacillin sodium, Naficillin sodium, Ampicillin, Amoxycillin .

2. Beta lactamase inhibitors: Clavulanic acid and its salts, Thienamycin.

3. Cephalosporins: Structure and uses of Cephalexin, Cephradine, Cefadroxil, Cefixime, Cefapyridine, Cefutroxime

4. Monolactams: Sulfazecin, Aztreonam, Tigmonam.

5. Aminoglycosides: Structural features and Mechanism of action, Streptomycin, Amikacin Neomycin, Kanamycin, Gentamycin, Netilmycin

6. Teracyclines: Chemistry and SAR, tetracycline, Chlortetracycline, Methacycline, Demeclocycline, Oxytetracycline, Meclocycline, Doxycycline, Minocycline.

7. Macrolide: Structure and specific uses of Erythromycin, Azithrocin, Oleandomycin.

8. Lincomycins: Lincomycin, Clindamycin.

9. Polypeptides: Gramicidin, Bacitracin, Polymyxin B, Colistin.

10. Miscellaneous: Chlormphenicol[$], Vancomycin, Novobiocin.

G. Antineoplastic agents: Introduction, mechanism of action and classification with examples.

1. Alkylating agents: Mechlorethamine, Cyclophosphamide[$], Melphalan, Chlorambucil[$], Busulfan, Lomustine[$],
2. Antimetabolites: Mercaptopurine, Thioguanine, 5-Flurouracil, Methotrexate,
3. Antibiotics: Dactinomycin, Bleomycin, Mitomycin, Streptozocin.
4. Plant products: Etopside ,Taxol, Camphothesin, Vincristine, Vinblastin.
5. Harmones: Dromostanalone, Megestrol,
6. Miscellaneous: Asparginase, Cisplatin, Hydroxy urea.
7. Immunotherapy: Interferon alpha 2a and 2b.

H. Cardiovascular agents :

1. Antianginal agents and vasodilators: Chemical structure and specific uses of Amyl nitrite, Nitroglycerine, Isosorbide dinitrate.

2. Calcium antagonists: Brief introduction of calcium channels and their blockers. Chemical structures and uses of Verapamil, Diltiazem, Nifedepine, Nimodepine, Felodepine Dipyridamole, Cyclandelate.

3. Antiarrhythmic drugs: Structure, chemical name, and classification of antiarrythmics with examples

   Class I- Membrane depressant drugs: Quinidine Procainamide, Phenytoin.
   Class II-Beta adrenergic blocking agents.Tocainide, propranolol
   Class III-Repolarization prolongators. Bretylium, Amiodarone
   Class IV-Calcium channel blocker. Diltiazem, Verapamil

4. Antihypertensive agents:

   Beta-blockers: Propranolol. Timolol
   ACE Inhibitors: Captopril, Enalapril
   Diuretics: Hydrochlorthiazide, Spiranolactone
   Calcium channel blockers: Nifedipine, Felodepine, Amlodepine
   á$_1$-Antagonist: Prazocin
   á$_2$- agonist: Clonidine, Guanithedine
   Miscelleneous: Resperpine, Hydralazine, Minoxidil

5. Antihyperlipidemic agents: Structure and specific uses.
   Clofibrate, Lovastatin, Cholesteramine, Colestipol.

6. Anticoagulants: Dicumorol, Warfarin[s], Phenindione.

7. Hypoglycemic agents: Sulfonyl ureas–Chlorpropamide[s], Acetohexamide, Glipizide,

8. Thyroid harmones : L-thyroxine, L-thyronine,

9. Antithyroid drugs: Propylthiouracil, Methimazole.

I. Diuretics: Introduction

1. Carbonic anhydrase inhibitors: Acetazolamide, Methazolamide.

2. Thiazide and Thiazide like diuretics: Chlorthiazides, Benzthiazide[s], Xipamide, Chlorthalidone.

3. High-ceiling or loop diuretics: Furosemide[s], Ethacrynic acid[s].

4. Potassium sparing diuretics: Spironolactone, Triampterene, Amiloride.

Miscellaneous: Mannitol.

IV B.Pharm
4.5: INDUSTRIAL PHARMACOGNOSY (Theory)

1. **Introduction:**
   a) Importance and status of herbal medicines and cosmetics.
   b) Brief account of herbal drug Industry.

2. **Phytopharmaceuticals:**
   Detailed methods of isolation, identification and estimation of the following: Quinine, Ephedrine, Digitoxin, Ca-sennosides, Diosgenin, Glycyrrhizin, Rutin, Andrographolides, Phyllanthin, Guggulusterone, Gymnemic acid, Asiaticoside,

3. **Herbal Formulations:**
   a) General introduction to alternative systems of medicine like Ayurveda, Siddha, Unani and Homeopathy.
   b) Methods of preparation of formulations in Ayurveda like Aristas, Asava, Ghutika, Taila, Churna, Leha and Bhasma.
   c) Role of herbs in cosmetics. Study of the following herbs. Shampoos: Soapnut
      Conditioners: Amla, Henna, Hair colorants: Amla,
      Henna
      Skin Care: Aloevera, Turmeric, Sandalwood
   d) Nutraceuticals: Spirulina, Garlic
   e) Different methods of processing extract

4. **Standardization:**

   a) Importance of standardization of raw materials, extracts and formulations with suitable examples.

   b) WHO guidelines for the assessment of crude drugs and extracts.

   c) Role of markers in the evaluation of Herbal drugs. Applications of HPLC and HPTLC for the evaluation of drugs and extracts.

   d) Standardization of the following drugs:

   i) Gokhru i) Aswagandha iii) Kalmegh iv) Brahmi v) Phyllanthus vi) Tinospora vii) Vasaka viii) Gymnema ix) Curcuma x)Glycyrrhiza

   e) Determination of alcohol content in Aristas and Asavas.

5. **Patenting of Natural Products**

6. **Plant Biotechnology and applications:**
   a) Polyploidy, Mutation and Chemodemes and their applications in improving the quality of medicinal plants .
   b) Tissue Culture:
      i) Types, techniques and applications
      ii) Callus and Suspension cultures.
      iii) Production of secondary metabolites.
      iv) Protoplast isolation and fusion
      v) Bio transformation, immobilisation of cells and enzymes.
   c) Transgenic plants and their applications: Gene transfer in plants using vectors and physical delivery methods

7. **Enzyme Biotechnology:**
   a) Introduction, general methods of isolation and purification of enzymes, enzyme reactors, applications of immobilized enzymes in drug manufacture and drug analysis.
   b) Sources, method of preparations, chemical natures and uses of Papain and Bromelain.
   c) Study of Streptokinase and Urokinase.

8. **Study of Traditional Drugs:**
   Common and vernacular names, source, active constituents and uses of
   i) Kantakari ii) Malkangani iii) Shatavari iv) Tylophora v) Bilva vi) Kalijeera
   vii) Karvera viii) Rasna ix) Apamarg x) Gokhru xi)Shankapushpi xii) Gaduchi
   xiii) Arjuna xiv) Shelajit xv) Chirata

IV B.Pharm

4.6.I: INDUSTRIAL PHARMACY

4.6.I (a): ADVANCED INDUSTRIAL PHARMACY

1. Controlled delivery systems: Principle, advantages, disadvantages, selection of drug candidates, approaches to design of controlled release formulations- methods such as ion exchange resins, microencapsulation (definition, applications, air suspension, coacervation and phase separation), matrix tablets, invitro evaluation.

2. Novel drug delivery systems: Concepts, advantages and disadvantages, types of drug delivery systems such as transdermal, nasal ocular, buccal with suitable examples. Drug carriers and drug targeting-Explanation and applications of liposomes, niosomes, microspheres, nanoparticles, advantages and disadvantages.

3. Methods to improve bioavailability of drugs: Solid dispersion and complexation

4. Pilot Plant and scale up: General considerations including significance of personnel requirements, space requirements, raw materials and preparation of Master procedure (SOP). Product consideration: Solid dosage forms in brief. Protocol preparation of multi- vitamin preparations

5. Herbal Formulations Antibacterial preparations, toothpaste, antitussive preparations – Definitions, formula and preparation.

6. Validation: Design, development of process validation, methods for pharmaceutical operations involved in the production of pharmaceutical products.

7. Formulation of Veternary products: Antibacterials, Anthelmentics, Antiamoebic in the form of bolus, powder and liquid.

8. Allergenic extracts: Allergy: Definition & manifestations, allergenic extracts, pollen, dust & fungal extracts.

IV B.Pharm
4.6.I: INDUSTRIAL PHARMACY
4.6.I (b): PHARMACEUTICAL MARKETING AND MANAGEMENT

1. **Marketing:**
   a. The meaning and scope of marketing.
   b. The Pharmaceutical market: Quantitative and qualitative aspects, size and composition of the market, demographic descriptions and socio psychological characteristics of the consumer, market segmentation.
   c. Analysing the market-Role of market research
   d. Consumer profile-Motivation and prescribing habits of the physician, patients' choice of physician and retail pharmacist.

2. **The Pharmaceutical product:**

   a. Market consideration in product development, marketing mix, product life cycle (PLC), effects of different elements of marketing mix at different stages of PLC, product classification, product planning, product differentiation, me-too products, modification of existing product.

   b. New product development-All stages from the new product idea to the stage of marketing the developed product (bulk drugs and formulations)

   c. Branding- Concept of brand, Different types of brand, importance and reasons for branding, packaging.

3. **The organization:**
   Manufacturer-Company objectives, influence of internal controls such as company policy on the company's operation, effects of Government regulations and controls on marketing practices.

4. **Distribution:**
   a. The wholesaler-His role in distribution of Pharmaceutical services offered to the manufacturer and the retailer, advantages and disadvantages of distribution through wholesaler.

   b. The retailer-Classification of retail institutions, advantages and disadvantages of retail institutions, the hospital as retail outlet.

5. **Competitive practices in the Pharmaceutical Industry:**

   a. Patent laws, trade marks laws.
   b. Price competition- Pricing, rate contracts.
   c. Non-price competition-All types of non-price competition with special emphasis on competition through research and development, competition through quality

6. **Promotions:**
   a. Communication and its importance
   b. Different ways of promotion- Advertising, direct mail, professionals, journals, sampling, retailing, medical exhibition, public relations.
   c. Professional sales representative-duties of PSR, purpose of detailing, selection and training, compensation and future prospects of the PSR.

7. **Management:**
   a. Concepts of management, Principles of management
   b. Primary functions of management - planning, organizing, staffing, directing controlling, motivation, entrepreneurship development.
   c. Secondary functions of management: decision-making, leadership, innovation, delegation of authority/responsibility.

8. **Good manufacturing practices (GMP):**
   GMP as per schedule M, WHO guidelines, USFDA guidelines, MCA guidelines and TGA guidelines.

9. **ICH guidelines:**
   Quality, efficacy and safety of drugs, impurity profiles.

IV B.Pharm
4.6.II: PHARMACY PRACTICE
4.6.II (a): PHARMACOKINETICS AND THERAPEUTIC DRUG MONITORING

1 a) Introduction to Pharmacokinetics, Types of pharmacokinetic models, Their advantages and limitations.

b) Model-Independent calculations (from equations as well as graphs) for pharmacokinetic parameters – Area under the curve, k_a, k_e, Biological half-life, Apparent volume of distribution and Clearance.

2. Compartment models:
   a) One compartment open model – monoexponential decline – IV bolus (blood & urine analysis), IV infusion and oral (Blood analysis).
   b) Two compartment model – biexponential disposition – IV bolus.
   c) Three compartment model – triexponential disposition – The concept.
   d) Multiple dosing – consequences, equations to calculate C_{min}, C_{max} and C_{ss}, accumulation index, concept of loading dose and maintenance dose.

3. Drug distribution:
   a) Factors affecting (perfusion & permeability)
   b) Protein binding – Kinetics of protein binding & Clinical significance.

4. Therapeutic Drug Monitoring:
   Introduction, Necessity of TDM, Criteria for valid TDM, Essentials for effective TDM, Organization of a TDM service, Effectiveness of TDM.

5. Analytical aspects of TDM, Uses of HPLC and Immunoassays in TDM for measurement of serum drug concentrations.

6. Dosage regimen design, Dosing of drug in special population – Pregnancy & lactation,

Pediatrics & Geriatrics, Dosage adjustment in renal and hepatic impairment, Patient compliance.

7. TDM. of selected individual drugs-Aminoglycosides, Carbamazepine, Cyclosporine, Digoxin and Methotrexate.

IV B.Pharm
4.6.II: PHARMACY PRACTICE
4.6.II (b): CLINICAL AND HOSPITAL PHARMACY

I. Clinical pharmacy and Therapeutics

1. Introduction to Clinical Pharmacy:

Definition, History and Development of Clinical Pharmacy, Study of daily activities of a clinical pharmacist like Drug therapy monitoring (Medication chart review, Clinical review, TDM, Pharmacist interventions), Ward round participation, Adverse drug reaction management,
Medication history interview and patient counseling.

2. Drug and Poison Information:
Requirements for setting up a Drug Information Center, Types of resources and Answering a Drug Information query.

3. Patient data analysis:
Clinical laboratory tests used in the evaluation of common disease states, and interpretation of test results of Liver function tests, Pulmonary function tests, Haemogram and Renal function tests.

4. Adverse drug reactions:
Epidemiology, Classification, Risk factors, Monitoring and detecting adverse drug Reaction
Assessiog Casuality using WHO scale and Reporting adverse drug reactions.

5. Definition, Symptoms, Classification of the diseases, treatment and parameters to monitor the therapy of following systems/diseases:

5.1 Cardiovascular system
Hypertension, Congestive cardiac failure and Ischaemic heart disease,

5.2 Respiratory system
Asthma.

5.3 Renal system
Acute and chronic renal failure.

5.4 Heamatological disease
Iron, B_{12} and Folic acid deficiency anaemias.

5.5 Endocrine System
Diabetes Mellitus.

5.6 Nervous System
Epilepsy.

5.7 Gastrointestinal System
Ulcer disease and Hepatitis.

5.8 Infectious disease
Gastro-enteritis, Pneumonia, Typhoid, Tuberculosis, Malaria and Amebiasis.

6. Concept of Essential Drugs and Rational Drug use.

II. Hospital and Community Pharmacy

1. The role of the hospital pharmacy, department and its relationship to other hospital departments and staff.

2. Hospital Drug Policy:

1. Pharmacy and Therapeutics committee.
2. Formulary and guidelines.

3. Organisation of Hospital Pharmacy Services:

1. Purchasing and Inventory control, Storage and drug recall procedure.
2. Drug distribution methods
3. Central sterile supply division

4. Research:

1. Practice-based research
2. Clinical trials.

5. The role of the community pharmacy and its relationship to other local health care providers.

6. Prescribed medication order and interpretation.

7. Patient counseling in community pharmacy including OTC products

8. Social Pharmacy:

1. General concepts of health and disease, disease causing agents and prevention of disease.
2. Classification of food requirements, balanced diet, nutritional deficiency disorders, their treatment and prevention.
3. Demography and family planning.

9. Code of Ethics for community pharmacists.

Paediatrics & Geriatrics, Dosage adjustment in renal and hepatic impairment, Patient compliance.

7. TDM. of selected individual drugs-Aminoglycosides, Carbamazepine, Cyclosporine, Digoxin and Methotrexate.

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Diabetes Mellitus.

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