M.Sc. Industrial Chemistry, Choice Based Credit System-2020-2022
Course Structure and Scheme of Examination

Semester	Course Code	Title of Paper(s)		Course Type	Credit				
					L	T	P	Total	Marks
FIRST	**IC-101**	Analytical Chemistry		Core	3	0	-	3	**100**
	IC-102	Physical Chemistry		Core	3	0	-	3	**100**
	IC-103	Organic Chemistry-I		Core	3	0	-	3	**100**
	IC-104	Major Elective	A. Paints & Pigments	Elective	3	0	-	3	**100**
			B. Bio-Chemicals						
	IC-105	Laboratory-I		Core	0	-	3	3	**100**
	IC-106	Laboratory-II		Core	0	-	3	3	**100**
	IC-107	Seminar		AE & SD	-	-	-	1	**100**
	IC-108	Assignment (Language/ Yoga/Social work/ Environment Science/ Physical Education)		AE & SD	-	-	-	1	**100**
		Total Valid Credits						**20**	
	IC-109	Comprehensive viva-voce exam		**Virtual credit**				**4**	**100**
	Total Credits for First Semester(Valid Credits + Virtual Credits)							**24**	**900**
SECOND	**IC-201**	Chemistry of Natural Products		Core	3	0	-	3	**100**
	IC-202	Organic Chemistry-II		Core	3	0	-	3	**100**
	IC-203	Unit Operations		Core	3	0	-	3	**100**
	IC-204	Major Elective	A. Polymer Science-I	Elective	3	0	-	3	**100**
			B. Medicinal Chemistry-I						
	IC-205	Laboratory-I		Core	0	-	3	3	**100**
	IC-206	Laboratory-II		Core	0	-	3	3	**100**
	IC-207	Seminar		AE & SD	-	-	-	1	**100**
	IC-208	Assignment (Language/ Yoga/Social work/ Environment Science/ Physical Education)		AE & SD	-	-	-	1	**100**
		Total Valid Credits20							
	IC-209	Comprehensive viva-voce exam		**Virtual credit**				**4**	**100**
	Total Credits for Second Semester(Valid Credits + Virtual Credits)							**24**	**900**

Semester	Course Code	Title of Paper(s)		Course Type	Credit				
					L	T	P	Total	Marks
THIRD	**IC-301**	Spectroscopy		Core	3	0	-	3	**100**
	IC-302	Organic Chemistry-III		Core	3	0	-	3	**100**
	IC-303	Major Elective	A. Polymer Science-II	Elective	3	0	-	3	**100**
			B. Medicinal Chemistry-II						
	IC-304	Major Elective	A. Pesticide Chemistry	Elective	3	0	-	3	**100**
			B. Pharmaceutics						
	IC-305	Laboratory-I		Core	0	-	3	3	**100**
	IC-306	Laboratory-II		Core	0	-	3	3	**100**
	IC-307	Seminar		AE & SD	-	-	-	1	**100**
	IC-308	Assignment(Social work/Yoga/ Language/Environ. Sc. /Physical Education)		AE & SD	-	-	-	1	**100**
		Total Valid Credits						**20**	
	IC-309	Comprehensive viva-voce exam		**Virtual credit**				**4**	**100**
	Total Credits for Third Semester(Valid Credits + Virtual Credits)							**24**	**900**
FOURTH	**IC-401**	IPR, TQM & Technology Management		Core	3	0	-	3	**100**
	IC-402	Advance Instrumental Techniques		Core	3	0	-	3	**100**
	IC-403	Organic Chemistry-IV		Core	3	0	-	3	**100**
	IC-404	Major Elective	A. Petrochemicals, Oils & Soaps	Elective	3	0	-	3	**100**
			B. Medicinal Chemistry-III						
	IC-405	Industrial Training & Project Viva		Core	0	-	6	6	**100**
	IC-406	Seminar		AE & SD	-	-	-	1	**100**
	IC-407	Assignment (Language/ Yoga/Social work/ Environment Science/ Physical Education)		AE & SD	-	-	-	1	**100**
		Total Valid Credits20							
	IC-408	Comprehensive viva-voce exam		**Virtual credit**				**4**	**100**
	Total Credits for Fourth Semester(Valid Credits + Virtual Credits)							**24**	**800**
Total Credits for the Course (20X4=80) + (4X4=16)								**96**	

Minimum Number of the Credits to be earned for the award of Degree=96

*Elective courses shall be conducted as per availability of permanent faculty

*AE & SD- Ability Enhancement and Skill Development

IC 101 - ANALYTICAL CHEMISTRY

UNIT- 1

Data Analysis

Types of errors, propagation of errors, accuracy and precession, significant figures, least square analysis, average, standard deviation, t test, standardization of analytical methods.

Titrimetric Methods of Analysis

General concept, stoichiometric calculations, acid-base titrations, titration curves, acid-base indicators, complexometric titration, metal ion indicator, precipitation titrations, adsorption indicators.

UNIT – 2

Gravimetric Methods of Analysis

Principles of gravimetric analysis, formation and properties of precipitates, applications of gravimetric analysis.

Solvent Extraction

Theoretical principle, classification, factors favoring extraction, extraction equilibrium, instrumentation and application.

UNIT – 3

Ion Exchange Chromatography

Theories, use of synthetic ion exchangers in separation, chelating ion exchange resins, liquid ion exchangers, experimental techniques and applications.

Separation Techniques

Classification of chromatographic techniques, difference between adsorption and partition chromatography, fundamentals of paper, thin layer, column and electrophoresis. Application of these techniques in qualitative and quantitative analysis.

UNIT – 4

Gas Chromatography

Gas solid chromatography (GSC): Principle, theory,instrumentation and applications

Gas liquid chromatography (GLC): Principle, theory, instrumentation, types of GLC columns and applications

HPLC

Principle, instrumentation, types of GLC columns and column materials, detector system, role of HPLC in qualitative and quantitative analysis, comparison of GC and HPLC.

UNIT – 5

Nephelometry and Turbidimetry
Introduction, general principles, instrumentation and application.

Flame photometry
Introduction, theory, instrumentation, interferences and factors affecting flame photometry.

Atomic Absorption Spectroscopy
Theory of atomic absorption spectroscopy, instrumentation, application in quantitative analysis.

IC 102 - ADVANCED PHYSICAL CHEMISTRY

UNIT – I

Surface Chemistry and Interfacial Phenomenon

Adsorption isotherm, estimation of surface area (BET), surface films of liquids, Sols, Gels, Emulsions, Micro emulsions, Micelles, (CMC); factors affecting CMC, counter ion binding to micelles, aerosols, effect of surfactants, Hydrotropes.

UNIT – II

Catalysis

Introduction, types – homogeneous and heterogeneous, basic principles, mechanism, factor affecting the performance, introduction to phase transfer catalysis, Enzyme catalyzed, Micelle catalyzed reaction – rate model, industrially important reactions.

UNIT – III

Kinetics

Method of determining rate laws, collision theory, ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, photochemical reaction (hydrogen – bromine reaction), kinetics of enzyme-catalyzed reactions, study of fast reactions (stop flow method, relaxation method, flash photolysis). Application of kinetics in finding out optimum conditions for different reaction.

UNIT – IV

Electro Chemistry

Standard electrode potential, galvanic series, galvanic cells, concentration cells, polarization, corrosion, classification, corrosion reactions, factors affecting corrosion, protection from corrosion.

Electroplating, applications of electroplating, mechanical preparation of surfaces, cleaning, rinsing, electroplating equipment and operating conditions, characteristics of electroplating wastes.

UNIT – V

Ionic Equilibria

The Ostwald's Dilution Law; concept of acids and bases; hard soft acids and bases; ionization constants of acids and bases; ionization of water (ionic product of water); the pH scale, common ion effect, buffer solutions, hydrolysis; Hydrogen ions (acid base) indicators; complex ion equilibria. The solubility product.

IC 103 - ORGANIC CHEMISTRY - I

UNIT –I

Reaction Mechanism

Structure and Reactivity: Type of mechanisms, type of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Curtin – Hammett Principal. Potential energy diagrams, transition states and intermediates, methods of determining mechanism, isotope effects.

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.

Effect of structure and reactivity – resonance and field effects, quantitative treatment. The Hammett equation and linear free energy relationships substituents and reaction constants. Taft equation.

UNIT – II

Aliphatic Electrophilic Substitution

Bimolecular mechanism – S_E2, S_Ei. The S_E1 mechanism, electrophilic substitution accompanied by double bond shift. Effect of substrate leaving group and the solvent polarity on the reactivity.

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagram. Ipso attack.

UNIT – III

Aliphatic Nucleophilic Substitution

The S_N2, S_N1, mixed S_N1 and S_N2 and S_NI mechanism. The neighbouring group participation of Л and σ bond. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and regioselectivity.

Aromatic Nucleophilic substitution

Mechanism, Effect of substrate structure, leaving group and attacking nucleophile.

UNIT – IV

Addition to carbon – carbon multiple bond

Mechanistic and stereochemical aspects of addition reactions involving elecrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity. Hydrogenation of double and triple bonds, Hydrogenation of aromatic rings, Hydroboration.

Addition to Carbon – Hetero Multiple bond

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl compounds, Wittig reaction.

UNIT – V

Elimination Reactions

The E_2, E_1 and E_1CB mechanism and their spectrum. Orientation of the double bond. Reactivity effect of substrate, structures, attacking base, the leaving group and the medium. Mechanism and orientation in Pyrolytic elimination.

Free Radical Reaction

Free radical substitution mechanism. Mechanism at an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates. The effect of solvent on reactivity. Allelic halogenation (NBS), Oxidation of aldehydes to carboxylic acid, auto oxidation. Sandmeyers reaction, Hunsdicker reaction.

IC 104 A – PAINTS AND PIGMENTS

UNIT – I

Pigments

General characteristics of pigments, Types of pigments, Blue pigments, Red pigments, Yellow pigments, Green pigments and Black pigments, General properties and methods of preparations of white pigments.

UNIT – II

Dyes

Introduction, General characteristics,colour and constitution, Basic operations in Dying Classification of dyes according to their mode of application and based on chemical constitution. Some commercial dyes viz.Azo dyes, Acid dyes, stilbeneazo dyes, Basic dyes, Indigo dyes, Reactive dyes, Disperse dyes.

UNIT – III

Printing Inks

Introduction, properties and uses of printing inks, Raw materials used in printing inks, Types of printing inks, Lithographic, Gravure, Flexographic and Screen inks, General process of manufacture of printing inks.

UNIT – IV

Paints and Varnishes

General characteristics of paint, varnishes and lacquers, their function, manufacture and classification. General account of enamel, emulsion paints, water based paints and japans.

UNIT –V

Paint & Varnish Formulations

Function of vehicle, solvent, thinner, pigment, dyes, filler, resins, drier, insecticides and additives in paint formulations.

Testing of formulations/paints

Viscosity, brush ability, color measurement, color matching, light fastness, opacity, drying time, adhesion, elasticity hardness, gloss, film thickness, wet and dry, fineness of grind, water resistance, humidity resistance, salt spray resistance, durability, weather meters.

IC 104 B - BIO-CHEMICALS

UNIT – I

Carbohydrates

monosaccharide, Disaccharide and polysaccharide.

Cyclic structure of glucose, Glycolysis, TCA cycle & its regulation & oxidation of pyruvateto acetyl CoA

Phosphogluconate (HMS) pathway, Gluconeogenesis and its regulation.

Disorders of carbohydrate metabolism.

UNIT – II

Proteins

Classification, structure & separation Biosynthesis of protein:

Structure, importance & biosynthesis of essential and nonessential amino acids.

Transamination & oxidative deamination of amino acids.

UNIT – III

Introduction and Classification of Enzymes, mechanism of enzyme – substrate complex

Factors governing enzyme activity, Isozymes, inhibition of enzymes

Co-enzyme: Introduction, classification and mechanism of action.

UNIT – IV

Introduction & classification of lipids.

Biosynthesis & oxidation of fatty acids including β-oxidation.

Ketonebodies& their oxidation.

Disorders of lipid metabolism.

UNIT - V

Introduction, classification of hormones.

Hormone receptors & intracellular messengers.

Hormones of thyroid, adrenal, gonads & pituitary.

Fat & water-soluble vitamins & their deficiency.

Lab Course –I Code: IC-105

- General experiments (Minor): 15
- Volumetric analysis (Major): 30
- Practical record: 05
- Viva Voce: 10
- Internal Assessment 40

General experiments (Minor)	1	To prepare molar and normal solutions.
	2	To prepare percent solution of given compound.
	3	To determine the strength of given solution of NaOH with N/10 oxalic acid.
	4	Determination of total acidity of given sample of water.
	5	Determination of total alkality of given sample of water.
	6	Determination of free CO_2 in a given sample of water.
	7	To determine total hardness of given H_2O sample by complexometric method.
Volumetric analysis (Major)	8	To standardize NaOH solution using oxalic acid solution and determine the strength of given HCl solution with standard NaOH solution.
	9	To determine the strength of given $K_2Cr_2O_7$ solution with N/10 sodium thiosulfate solution.
	10	Find out volumetrically the amount/lit. of $FeSO_4(NH_4)SO_4.6H_2O$ present in solution acidified with H_2SO_4.
	11	Determination of Temporary and Permanent Hardness of given sample of water.
	12	To determine the Ca^{2+} and Mg^{2+} hardness of given water sample.
	13	To determine the strength of a given $CuSO_4$ solution with N/20 sodium thiosulphate solution.
	14	Determination of chloride content of a water sample by Mohr's method.

Lab Course –II Code: IC-106

- General experiments: 15
- Chromatography: 30
- Practical record: 05
- Viva Voce: 10
- Internal Assessment 40

General experiments	1	Purification and distillation of tap water.
	2	To determine the moisture content of a given sample by oven heating method.
	3	Preparation of rose water by simple distillation.
	4	Preparation of urea formaldehyde resin.
	5	Preparation of phenol formaldehyde resin.
	6	Determine the degree of hydrolysis and hydrolysis constant of CH_3COONa.
	7	To determine the total alkalinity in a given sample of water using std. sulphuric acid.
	8	To determine the adsorption isotherm of acetic acid by activated charcoal.
Chromatography	9	To separate the given amino acid mixture by paper chromatography.

IC 201 - CHEMISTRY OF NATURAL PRODUCTS

UNIT – I

Terpenoids and carotenoids

Classification, occurrence, isolation, general methods of structure determination, isoprene rule, stereochemistry. Synthesis and industrial uses of following representative molecules: citral, geraniol, Menthol, zingiberene, β-carotene.

UNIT – II

Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloid in plants, structure, stereo chemistry, synthesis and biosynthesis of the following; Conine, Nicotine, atropine, Quinine.

UNIT – III

Perfumes

Constitution of perfumes, odorous substances, Extraction of perfumes from plants, synthesis of some important synthetic chemicals used in perfume industry esters, phenylethyl alcohol, citronellol, linalool, geraniol, ketone, civetone, muscone, Musk ambrette, musk xylene, coumarin, β-ionone, aldehyde, vanillin, haliotropin, perfume formulation, some representative formulation of rose, jasmine, sandal wood, Fancy perfumes, lavender etc.

UNIT – IV

Carbohydrate and Fermentation Industries

Manufacture of sugar. Manufacture of starch, dextrin from corn, Potato, rice and tapioca. Industrial alcohol, manufacture of absolute alcohol, Beer, Wine, Distilled spirit, Butyl alcohol, Acetone, Acetic acid, Citric acid, Lactic acid, Oxalic acid etc.

UNIT –V

Milk and Milk Products, Chemical Composition, Processing of milk, Types of milk, Analysis of Milk and Composition, uses and manufacturer of various milk products viz cream, butter, ghee, cheese, condensed milk, casein, khoa, milk powder, infant milk food, malted milk powder, ice-cream, fermented milk products.

IC 202 - ORGANIC CHEMISTRY – II

UNIT– I

Stereo Chemistry

Conformational analysis of cyclohexane, decalins, effect of conformation on reactivity. Steric strain due to unavoidable crowding. Element of symmetry, chirality, molecules with more than one chiral center. Threo and erythro isomers, methods of resolution, optical activity, enantiomeric and diastereomeric compounds, stereospecific and stereoselective synthesis. Optical activity in absence of chiral carbon (biphenyls, allenes, spiranes) .

UNIT– II

Asymmetric Synthesis

Definition, asymmetric discrimination, reactant control and product control in the enensioselective step. Asymmetric catalytic hydrogenation of olefins, ketones, mechanism of asymmetric hydrogenation. Asymmetric double bond migration, Asymmetric hydrocarboxylation, Asymmetric Diels Alder reaction, Asymmetric oxidation, Asymmetric catalysis by biochemical systems. Economic significance of asymmetric synthesis.

UNIT – III

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadience, 1,3,5 hexatriene and allyl systems. Classification of Pericyclic reactions. Wood ward – Hoffman correlation diagrams. FMO and PMO approach. Electrocyclic reaction – conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cyclo additions – antarafacial and supraficial additions, 4n, 4n+2 systems, 1,3 dipolar cyclo addition. Sigmatropic rearrangements – suprafacial and antarafacial shift of "H", sigmatropic shifts involving carbon moieties 1,3 and 5,5 sigmatropic rearrangements. Claisen,cope and aza – cope rearrangements.

Photochemistry

Cis-trans isomerization, Paterno – Buchi reaction, norrishtype –I and II reactions, photo reduction of ketones, photochemistry of arenes.

UNIT – IV

Oxidation

Introduction, Different oxidative processes. Hydrocarbons – Alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, carboxylic acids, amines, hydrazines and sulphides. Oxidation with RuO_4, iodosobenzenediacetate etc.

UNIT – V

Reduction

Introduction different reductive processes. Hydrocarbons – alkenes, alkynes, aromatic rings. Carbonyl compounds – aldehydes, ketones, acids. Epoxides, Nitro compounds,azo and oximes.

IC 203 - UNIT OPERATIONS

UNIT – I

Distillation

Introduction; VLE, Batch and continuous distillation, Reflux ratio, q-line, Azeotropic, Steam and extractive distillation.

Equipment: plate columns and packed columns.

Absorption

Introduction, Liquid gas equilibrium selection criteria for solvent minimum gas liquid ratio type of packing. Equipments – packed columns, spray columns, bubble columns, packed bubble columns, mechanically agitated contactors.

UNIT - II

Evaporation

Introduction; Equipments short tube (standard) evaporator, forced circulation evaporator, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporators.

Heat Exchanger

Introduction; Equipments double pipe, Shell and tube, U-tube, Fine tube Heat exchanger

UNIT – III

Crystallization

Introduction : Solubility, super saturation, nucleation, crystal growth, Equipment – tank crystallizer, agitated crystallizer, evaporator crystallizer.

Extraction

Introduction : selection of solvents, Equipments – spray column, packed column, rotating disc column, mixer settler.

UNIT – IV

Filtration

Introduction, Filter media and filter aids, Equipment – Plate and frame filter press, rotatory drum filter, candle filter, bag filter, centrifuge filter.

Size Reduction and size Separation

Definition, objectives of size reduction, factors affecting size reduction, ball mill, hammer mill, fluid energy mill.

UNIT – V

Drying

Introduction; free moisture, bound moisture, drying curve, Equipments – tray drier, rotary dryer, flash dryer and spray dryer.

Mixing

Theory of mixing, solid – solid, solid-liquid and liquid – liquid mixing equipments

IC 204 A POLYMER SCIENCE – I

UNIT –I

Concept of polymers, polymerization, definition, classification and types, Bonding in polymers.

Condensation polymerization – types extent of condensation and degree of polymerization. Cross-linking, gel point and ring opening polymerization.

Addition polymerization free radical & Ionic chain transfer and inhibition. Co-ordination polymerization Ziegler copolymerisation – mechanism of copolymers block and graft copolymers. Kinetics of co-polymerisation.

UNIT – II

Chemical properties

Hydrolysis, acidolysis, aminolysis, hydrogenation, addition, substitution isomerisation, cyclization and cross linking reactions of polymer.

Polymerization kinetics and Techniques

Free radical, cationic, anionic and radiation, polycondensation, mass, solution, emulsion and suspension polymerizations, Advantages and disadvantages of the techniques and of the products from them.

UNIT – III

Molecular mass

Relative molecular mass, mw, mn and polydispersibility colligative property measurement and group analysis. Light scattering, ultra centrifugation, osmotic pressure and viscosity methods of molecular mass measurement. Gel permeation chromatography.

Glassy state, glass transition temperature, Mechanisms of glass transitions temperature, Factors influencing the glass transition temp, Relation of glass transitions temperature with molecular weight and melting point. Importance of glass transition temperature, crystallinity in polymers

UNIT – IV

Rubber

Materials and Processing Technology

Introduction, types, thermoplastic elastomers (TPE), compounding and processing technology, vulcanization of elastomers, theory and accelerator action of sulphur vulcanization, non-sulphurvalcanization, ebonite latex technology, some major rubber products.

Polymer degradation and stabilizers

Thermal degradation, photo degradation, Oxidative degradation, biological degradation, the role of antioxidants and stabilizers.

UNIT – V

Plastics Materials

Introduction, Synthesis, properties and uses of following:

1. Polyethylene
2. Polystyrene
3. Acrylic fibers
4. Polyamides
5. Polycarbonates
6. Cellulose plastics
7. Silicones
8. Poly Vinyl Chloride
9. Polyurethane's

IC 204 B - MEDICINAL CHEMISTRY-I

UNIT– I

General Pharmacological Principles

a) Drug nomenclature, routes of drug administration.

b) **Pharmacokinetics:** Passive diffusion and filtration, specialized transport, absorption, bio-availability, distribution, bio transformation (metabolism), Excretion, clearance, plasma half life, loading and maintenance dose, prolongation of drug action.

c) **Pharmacodynamics:** Principles of drug action, mechanism of drug action, drug response relationship, drug dosage, factors modifying drug action.

d) Adverse drug effects.

UNIT - II

Antipyretics analgesics

a) **Antipyretic drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of paracetamol, acetanilide, asprin, cincophen, phenazone, mefenanic acid.

b) **Opoid analgesic or Narcotic analgesic drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Morphenesulphate, codeine, levorphanon tartrate, pethidine hydrochloride.

c) **Non steroidalanti inflammatory drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Indomethacine, Ibuprofen, Neproren, Auranofin.

UNIT- III

a) **Sulphonamides:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Sulfanilamide, Sulfathiazole, Sulphadiazine, Sulfacetamide, Mafenide

b) **Cotrimoxazole, Quinolones and Fluroquinolones:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of cotrimoxazole, ciprofloxacin, norfloxacin.

c) **Anti Cancer Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis of Cyclophosphamide, Melphalan, Busulfan, Methotrexate.

UNIT - IV

Antibiotics

a) **β-Lactam antibiotics:** Classification, pharmacology, mode of action, adverse effects, synthesis of Penicilline (Benzyl penicilline, cloxacillin, ampiciline) and Cephalosporins (cephalexin).

b) **Aminoglycocides Antibiotics:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Streptomycin, neomycin.

c) **Tetracyclines and chloramphenicol:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Tetracycline, Minocycline and Chloramphenicol.

d) **Mecrolide Antibiotics:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Erythromycin.

e) **Treatment of urinary tract infection:** Antimicrobial agents

UNIT -V

a) **AntitubercularDrugs:**Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship ofIsoniazid, Rifampin, Streptomycin.

b) **AntileproticDrugs:**Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Dapsone, Clofazimine.

c) **Antimalerial Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Chloroquine, Primaquin Phosphate.

d) **Antiamoebic& Antiprotozoal Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Mtroniadazole, DiloxanideFuroate, Pentamidine.

Lab Course –I Code: IC-205

- Organic synthesis: (Major & Minor) 25+20 = 45
- Practical record: 05
- Viva Voce: 10
- Internal Assessment 40

Organic synthesis	1	To synthesize benzanilide from aniline.
	2	To synthesize benzoic acid from benzanilide.
	3	To prepare phthalamide from phthalic anhydride.
	4	To synthesize 2,4,6-tribromoaniline from aniline.
	5	To prepare p-nitroacetanilide from acetanilide.
	6	To prepare methyl orange from sulphanilic acid.
	7	To prepare phenyl azo β-naphthol from aniline.
	8	To prepare β-naphthyl benzoate from β-naphthol.
	9	To prepare p-iodoacetanilide from acetanilide.
	10	To synthesize phenyl benzoate from phenol.

Lab Course –II Code: IC-206

- Natural products isolation: (Major & Minor) 25+20 = 45
- Practical record: 05
- Viva Voce: 10
- Internal Assessment 40

Natural products isolation	1	To isolate cellulose from cotton.
	2	To isolate β-carotene from carrot.
	3	To isolate lycopene from tomato.
	4	To prepare glucose from cane sugar.
	5	To isolate caffeine from tea leaves.
	6	To extract oleoresin from red chili.
	7	To extract clove oil from clove buds through distillation and characterization by melting point, TLC and density.
	8	To isolate casein from milk.

IC 301 - SPECTROSCOPY

UNIT – I

UV-visible Spectroscopy

Theory, Instrumentation, Characteristic absorption of organic compounds. Woodward and Fiser rules for calculating λ max, Interpretation of spectra, Application of UV-visible spectroscopy.

Photo electron spectroscopy

Theory and application of UV and X-Ray photo electron spectroscopy, general idea of auger photoelectron spectroscopy, applications of photoelectron spectroscopy and Auger spectroscopy to the study of surfaces.

UNIT – II

Infrared Spectroscopy

Theory, vibration modes, degree of freedom for linear and non linear molecules, instrumentation (Dispersive and non dispersive), applications and interpretation of spectra, GC-IR analysis.

Raman Spectroscopy

Introduction, Stokes line, anti stokes line, Theory, Raman shift, applications.

UNIT – III

Nuclear Magnetic Resonance Spectroscopy

Theory, Chemical Shift, Spin-spin splitting, environmental effect on NMR spectra. Instrumentation, rules governing the interpretation of H^1 NMR spectra. Application of ^1H NMR to quantitative analysis

^{13}C NMR : Historical Development, various terms used in C^{13} NMR, application of C^{13} NMR to structure determination, two dimensional NMR spectroscopy

UNIT – IV

ESR: Concept, comparison between NMR and ESR, theory, instrumentation, presentation of ESR spectra, application, ENDOR, ELDOR

NQR: Theory, interaction of nuclear quadrupole with electromagnetic radiation, Instrumentation & applications ofnuclear quadrupole spectroscopy .

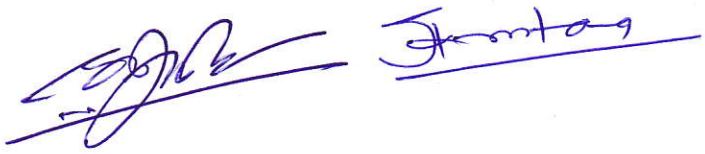
UNIT –V

Mass Spectroscopy

Concepts in Mass spectroscopy, Instrumentation, rules of spectral interpretation and application of Mass spectroscopy, Mclafferty rearrangement, acylium ion, oxonium ion, tropolium ion, molecular ion and metastable ion

Mossbaur (Fe &Sn)

General theory, instrumentation and important applications of Mossbaur Spectroscopy.



IC 302 - ORGANIC CHEMISTRY - III

UNIT – I

Reagents in organic synthesis

Complex metal hydrides, Gilman's reagents, lithium dimethyl cuprate, lithium disopropylamide, dicyclohexilecarbodimide 1,3 dithiane, tri methyl silyliodide, tri–n-butyl tin hydride, DDQ, Phase transfer catalyst, crown ethers, Wilkinson's catalyst, Baker's yeast.

UNIT – II

Heterocyclic Chemistry

Synthesis and reactivity of furan, Thiophene, pyrrole, pyridine, Quinoline, Isoquinilone and indoleskraup synthesis, Fiesherindole synthesis.

UNIT – III

Molecular Rearrangement

Pinacol/Pinecolone rearrangement, Wagner-meerwein rearrangement, wolff, hoffman, curtius, lossen, Schmidt, Backman, Favorskin, Aston, Fries, Claisen, Shapiro.

Protecting Groups

Protection of organic functional groups, protecting reagents and removal of protecting groups.

UNIT – IV

Organic Reactions

Friedal-craft, Cannizaro, Aldol, Perkin, Stobbe, Dieckmann condensation, Reimer-Tiemann, Reformatsky, Diels-Alder, Robbinson annulation, Favorksin, Stork-enamine reaction, Michael, Petersons synthesis, Chichibabin reaction.

UNIT – V

Organic Synthesis - A disconnection approach

Introduction of disconnection, concepts of synthesis, synthetic equivalent, functional group interconversion, concepts and design of synthesis, criteria of good disconnection.

One group disconnection

Disconnection and synthesis of alcohols, olefins, simple ketone and acids.

Two Group disconnection

Disconnection in 1,3dioxygenated skeletons, preparation of β-hydroxycorbonyl compounds, disconnection and synthesis of acyclic and cyclic hetero compounds.

IC 303 A - POLYMER SCIENCE II

UNIT - I

Polymer Rheology and Morphology

Introduction stress and strain, ideal elastic solid, Newtonian and non-newtonian fluid. Apparent viscosity the power, low molecular hole concept, weissenberg effects, reheological properties of fluid, melt fracture and irregular, time dependent flow, viscoelastic behaviour, mechanical model of a viscoelastic material relaxation enhancement under constant stress. Hysteresis, creep and relaxation of typical plastics.

Physical & mechanical testing of Polymer

Stress-strain measurement, dynamic mechanical behaviour, stress cracking, hardness, tear strength or tear resistance, resilience's, flex cracking resistance, abrasion resistance, impact resistance.

UNIT – II

Polymer processing

Compression moulding, casting, extrusion, injection moulding, thermoforming, Fibrespinning(melt, dry and wet spinning)

Polymer Products

Belting, hoses, rubber footwear, Rubber to metal bonded components, cellular rubbers, sports goods, cables, latex products, rubber rollers, extruded and moulded products.

UNIT – III

Functions and example of compounding ingredients

(1) Activators
(2) Accelerators
(3) Blowing agents
(4) Softners
(5) Pigments
(6) Tactifers
(7) Release agents
(8) Reclaimed rubber
(9) Tactics
(10) Ground crumb
(11) Mineral rubber
(12) Retardecs

Fillers

Carbon Black: Introduction manufacturer and morphology, Physical & chemical properties, effect of carbon black properties on compounding, mixing & dispersion.

Non Black Fillers: Introduction manufactures characteristics and application of calcium carbonate, clays, silica in the rubber industry.

UNIT – IV

Adhesives – Solvent based, water based and adhesives based on various polymers. Epoxide resins curing of epoxide resins. Dilutents and other additives and their applications.

Composite materials, properties, advantages and methods of preparation.

Blends: Preparation, processing, properties uses and Industrial aspects.

UNIT – V

Chemical Testing

Identification of materials by; elemental and solubility analysis. Identification by colour tests. Estimation of specific chemical characteristics like; acid number, saponification value and hydroxyl value. Solvent extractions and its analysis for polymers

Analysis & Testing of Polymers

Thermal analysis: DSC, TGA, TMA, DTA

IC 303 B - MEDICINAL CHEMISTRY –II

UNIT - I

Drugs acting on gastrointestinal disorders

(a) Agents for control of gastric acidity and treatment of peptic ulcers: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Ranitidine, Sodium bicarbonate, Magnesium Hydroxide, Aluminum Hydroxide Gel, Sucralfate.

(b) Emetics and Antiemetics drugs.

(c) Drugs for constipation and Diarrhoes: Classification, pharmacology, mode of action, adverse effects, synthesis of Bran, Ispaghula, Diphenylmethanes, Sulfasalazine, Codeine.

UNIT - II

Cardiovascular drugs

a) **Cardiavascular Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Digoxin, Digitoxin, Clonidine, Hydralazine, Methyldopa, Nitroglycerine, Isoxsupurine, Prenylamine, Disopyramide Phosphate, Procainamide Hydrochloride.

b) **Hematopoietic Agents:**Groth factors, minerals, anticoagulants, thrombolytic and antiplatelate drugs

UNIT - III

Drugs acting on Kidney

a) **Diuretics:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Chlormerodrin, Hydrochlorothiazide, Acetazolamide, Chlarthlidona, Furosemide, Spironolactone, Mannitol.

b) **Antidiuretics:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Lypressin, Amiloride, Carbamazepine.

UNIT - IV

(a) **Drugs of Arthritides& Gout:** Classification, pharmacology, mode of action, adverse effects, synthesis of d-Penicillamine and NSAIDs, synthesis and structure activity relationship of, Chloroquine, Sulfasalazine, Colchicine, Allopurinol.

(b) **Drugs of Cough and Bronchial Asthama:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Codeine, dextromethorphan, bromhexine, ambroxol, guaiphenesin, isoprenaline, salbutamol, Theophylline, Aminophylline, Atropinmethonitrate, ketotifen.

UNIT - V

a) **Drugs acting on skins and mucous membrane:** Demulcents (Glycerine), Emollients (Vegetable Oils), Adsorbents and protectives (Calamine, Zinc Oxide, Zinc/ Magnesium stearate, Dimethicone), Astringents (Tannia acid, alcohol, minerals), Melanizing Agents, Drugs of Psoriasis (Calcipotriol), Demelanizing Agents (Hydroquinone, Monobenzone), Sunscreens, Drugs for acne vulgaris (Benzoyl peroxide, Retinoic acids, Antibiotics, Isotretinoin).

b) **Anti Fungal Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of amphotericin B, Ketoconazol, Griseofulvin, Itaraconazol.

c) **Antiviral Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Acyclovir, Amantidine hydrochloride, Zidovudine.

IC 304 A - PESTICIDE CHEMISTRY

UNIT - I

Classification of Pesticides structure, synthesis, mode of action and application of environmental impact of following:

Insecticide of Plant Origin: Nicotine, Pyrethroids, Allthrin.

Fungicides: Dichlone, Captan

UNIT - II

Structure, synthesis, mode of action, application, SAR& environmental impact of following:

Chlorinated hydrocarbon: BHC, Heptachlor, Aldrin, Dieldrin, Endosulfar

UNIT - III

Structure, synthesis, mode of action, application & environmental impact of following:

Organo Phosphorous insecticides: Dichlorovos, Paraoxon

Dithio phosphoric acid derivatives: Malathion,

Thio phosphoric acid: Parathion, Demetron, Chlorthion etc.

Pyrophosphoric acid derivative: TEPP

UNIT – IV

Structure, synthesis, mode of action, application & environmental impact of following:

Carbonate insecticides: Carbaryl, Baygon

Rhodenticide : Zinc Phosphide, Warfarin, Fluoroacetamide.

UNIT –V

Formulation of Pesticides

Dry formulations: Dusts, granules, we table powders, seed disinfectant.

Liquid formulation: Emulsions, suspensions, aerosols and sprays.

IC 304 B - PHARMACEUTICS

UNIT - I

The design of dosage forms and Preformulation

a) **Design of Dosages Forms:** Principles of dosage form design, biopharamaceuticals consideration in dosage form design, routes of drug administration, drugs factors in dosage form design, therepeutics consideration in dosage form design,

b) **Preformulation:** Concept of preformulations, Uxorious aspects of preformulations, spectroscopy, solubility, melting point, powder flow properties, assay development.

UNIT - II

Physiochemical Principles of Pharmaceutics

a) **Viscocity, Rheology and the flow of fluids :** Newtonian and Non-Newtonian fluids, viscosity values for Newtonian fluids, determination of the flow properties of simple fluids, types of non-Newtonian behaviour, determination of the flow properties of non-Newtonian fluids, the effects of rheological properties on bioavailabality.

b) **Solubility and dissolution rate:** Methods of expressing solubility, prediction of solubility, solubility of liquids in liquids, solids in solids, gases in liquids and solids in liquids, dissolution rate of solids in liquids, factors affecting dissolution rates, measurement of dissolution rates

UNIT – III

a) **Disperse systems:** Colloids, Preparation of colloids, properties of colloids, physical stability of colloidal systems, gels, surface active agents, micellizations, solubilization, detergency.

b) **Biopharmaceutics:** Concept of Bioavailbility and Biopharmaceutics, factor influencing bioavailability, assement of bioavailability, representation of bioavailability data, absolute and related bioavailability, one compartment open model of drug disposition in the body. Dosage regimens and their influence on the concentration, time profile of a drug in the body.

UNIT – IV

Study of Pharmaceutical Dosages Form Design Consideration

a) **Tablets:** Types of tablets, tablets ingredients, diluents, binders, disintegrants, lubricants, colors, flavours, sweeteners, types of coating.

b) **Tablet Standardization:** Hardness, friability, weight variations, disintegration, dissolution and content uniformity tests.

c) **Capsules:** Hard geletins capsules – capsules size formulation and preparation of filled hard gelatins capsules, soft geletin capsules (soft gels) –Manufacturing procedures, quality control of capsules.

UNIT – V

a) **Pharmaceutical Preparations:** Principles and procedures involved in the dispensing of following classes of pharmaceutical dosages form – solutions, aromatic water, syrups, elixirs, spirits, tinctures, mixtures, lotions, liniments, throat paints.

b) **Suspensions:** Introduction, flocculations and deflocculating, sedimentations parameters, role of wetting, suspension formulation, evaluation of suspension stability.

c) **Emulsions:** Introduction, types, detection, thermodynamic consideration.

Lab Course –I Code: IC-305

- Instrumentation:
  - Minor 15
  - Major 30
- Practical record: 05
- Viva Voce: 10
- Internal Assessment 40

Minor experiments	1	Determination of acidity of water sample.
	2	Determination of acid value of oil.
	3	To determine density of given liquid with respect to water using pyknometer/RD bottle.
	4	To determine the relative viscosity of given liquid with respect to water by Ostwald's viscometer.
	5	To determine surface tension of given liquid by stalagmometer.
Major experiments	6	To prepare buffer standardization of pH meter and determine the molarity of HCl pH-metrically provided M/10 NaOH.
	7	To verify Beer Lambert's law with the help of colorimeter and find out the concentration of unknown solution.
	8	To determine the turbidence of given unknown solution using Nephlo-turbidimeter.
	9	Determination of total alkality of given sample of water.
	10	To determine the Ca^{2+} and Mg^{2+} hardness of given water sample.
	11	To determine total hardness of given H_2O sample by complexometric method.
	12	Determination of Temporary and Permanent Hardness of given sample of water.
	13	Determination of free CO_2 in a given sample of water.

Lab Course –IICode: IC-306

- Drug Analysis
  - Minor 15
  - Major 30
- Practical record: 05
- Viva Voce: 10
- Internal Assessment 40

Quality assurance of drugs	1	To determine hardness of given caplet.
	2	To determine the bulk density of given powder.
	3	To determine friability of given caplet and tablet.
	4	To determine % dissolution of given caplet and tablet.
	5	To determine the disintegration of given tablet and caplet.
	6	To determine the amount of acetic acid and present in a given sample of vinegar.
	7	To prepare alumina from potash alum.
	8	To prepare Di-nitro methylene tetra amine (DNPT) from hexamine
	9	To prepare Calcium Stearate from stearic acid.
	10	To analyse the Antacid Tablets provided to you.
	11	To prepare Aloe Vera gel.
	12	To determine the Acidity of the fruit provided to you.

IC 401 - IPR, TQM & TECHNOLOGY MANAGEMENT

UNIT – I

Role of patent in the pharmaceutical industries: Pharmaceutical legislation in India, Code of professional Ethics, pharmacy Act 1948, The drugs and cosmetics Act 1940, Drugs and Magic Remedies (Objectionable Advertisement) Act 1954, Narcotic Drugs and Psychotropic Substances Act 1985, Drug Price control order 1995.

UNIT – II

IPR, management of IPR, various IPR, Viz. copyrights and traditional knowledge, patents, condition of patentability, steps to obtain a patent, source of patent information, infringement analysis.

UNIT – III

Concepts of ISO, Total Quality Management (TQM), Six Sigma, Kaizen, JIT, Total Quality Control (TQC), Total Waste Elimination (TWE), Total Productive Maintenance (TPM).

UNIT – IV

Concepts and guidelines of USFDA, Good Manufacturing Practices (GMP)guidelines, Good Clinical Practices(GCP)guidelines, International council for Harmonization(ICH) guidelines, research methodology used in CRO

UNIT –V

Technology Management: Basic concepts, role and importance to technology management, Technological change, and Technology life cycle, diffusion and growth of Technology, Technology planning, Technology dev. and strategies,

Technological forecasting, Technology generation and development and Technology transfer.

IC 402 - ADVANCED INSTRUMENTAL TECHNIQUES

UNIT – I

ThermoanalyticalMethods:thermogravimetry, factors affecting thermogravimetric curves, derivative thermogravimetry (DTG), thermobalance. Applications of thermogravimetry, differential thermal analysis, factors affecting DTA curves, instrumentation, application of DTA.

Differantial scanning colorimetry (DSC), theory, instrumentation, applications of DSC, thermometric titrations, principal classification. Instrumentation and application of thermogravimetric titrations and online analysis.

UNIT – II

Electro analytical methods:

Electrogravimetric analysis, theory, apparatus cell process, deposition and separation. Electrolytic separation of metals.

Coulometry, apparatus and general techniques controlled potentialcoulometery.

Potentiometry – Fundamentals, reference electrodes(Hydrogen, calomel, silver and silver chloride electrode).

Indicator and ion selective electrode, instrumentation and measurement of cell and emf conductance and conductometric titrations

UNIT –III

Diffraction techniques : General theory and instrumentation of neutron diffraction and X-Ray diffraction. Applications of X-Ray diffraction for characterization and structure of materials. Application of neutron diffraction to structure of magnetic materials.

UNIT – IV

Refractrometry, Polarimetery, Flouroscence and Phosphorancespectrometery. Optical Rotatry dispersion (ORD) and circular dichroism (CD) theory, instrumentation and application of above techniques.

UNIT –V

Surface characterization by spectroscopy and microscopy, Introduction, surface scanning electron microscopy, scanning probe microscope.

Supercritical fluids chromatography and extraction

Properties of super critical fluids, super critical fluids chromatography and super critical fluids extraction

IC 403 - ORGANIC CHEMISTRY –IV

UNIT – I

Nitration: nitrating agents, aromatic nitration, kinetics and mechanism of aromatic nitration. Nitration of paraffinic hydrocarbons. Process equipment for technical nitration. Recent reagents used in nitration. Typical industrial nitration process

UNIT- II

Halogenations: Halogenating agents, thermodynamics and kinetics of halogenation reactions. Chlorination in the presence of catalyst. Photo halogenation, design and construction of equipment for halogenation. Typical industrial halogenation process.

UNIT – III

Sulphonation: Sulphonating agents and their principle applications. Physical and chemical factors in sulphonation. Kinetic, mechanism and thermodynamic. Desulphonation reaction, industrial equipments and techniques. Typical industrial sulphonation process.

UNIT – IV

Esterification: Esterification of organic acids. Ester of inorganic acids. Typical industrial esterification reaction.

Hydrolysis: Hydrolysing agents, kinetic mechanism and thermodynamic of hydrolysingequipments for hydrolysis. Typical industrial hydrolytic reaction.

UNIT – V

Alkylation: Types of alkylation, alkylating agents, factor controlling alkylation. Kinetics and mechanism, some industrial alkylating process.

Amination: Aminatingagents physical and chemical factors affecting aminolyting. Catalyst used in aminating reaction. Kinetics of aminolysis. Design of reactor technical manufacture of amino compounds.

IC 404 A - PETROCHEMICALS, OILS & SOAPS

UNIT – I

Petrochemicals: Constituents of Petroleum, Processing or Refining, Petrochemicals, Feedstock's, Preparation of methane, ethylene, propylene, butylenes and cyclic compounds from petrochemical.

UNIT – II

Oils: Edible and nonedible oils, chemical composition and physical properties of vegetable oils, Method of extracting oils, Hydrogenation of oils.

UNIT – III

Soaps and detergents: Cleaning agents, Soaps, manufacture of soaps, Glycerin, Methods of production of glycerin, Detergents, manufacture of various kinds of detergents, cleaning action of soaps and detergents, Use Pattern, Soapanification value, Acid values, Iodine value, Total fatty matter.

UNIT – IV

Surfactant & Disinfectant: Surfactants, classification of surfactant, Raw material of surfactants, Different Bleaching agents, Function of bleaching agents.

Disinfectant, classification of disinfectant, and its application, Phenolic derivative as disinfectant, Phenolic coefficient.

UNIT –V

Lubricants: Introduction, surface energy, Adsorption, Laws of friction, Theories of wear, Lubrication, Mechanism of Lubrication, Classification of Lubricants, Lubricating emulsions. Properties of lubricants. Flash point, Fire point, Smoke point, Turbidity point.

IC 404 B - MEDICINAL CHEMISTRY – III

UNIT– I

Drugs acting on CNS:

(a) Introduction, site and mechanism of action of some neurotransmitters Dopamine, Acetyl choline, GABA, Histamine.

(b) **General and Local anaesthetics.** Classification, pharmacology, mode of action, adverse effects, synthesis of Ether, Halothane, Nitrous Oxide, Chloroform, Thiopentone sodium, Ketamine hydrochloride, Lignocaine hydrochloride, cinchocaine, phenacainieHCl, Ethyl- p-amino benzoate.

UNIT- II

a) **Sedatives and hypnotics:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Barbiturates (Barbiton, Phenobarbital, Allobarbital, Thiopental sodium), Benzodiazepines (Diazepan, buspirone) and alcoholic hypnotics.

b) **Tranquilizers or Antianxiety Agents:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Chlorpromazine, Haloperidol, Benzodiazepines.

UNIT– III

(a) **Anticonvulsants and Antiepileptic drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Phenobarbital, Phenytoin Sodium, Trimethadione, Phensuximide, Primidone.

(b) **CNS stimulants:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Caffeine, Theophylline, Doxapram, Cocaine.

(c) **Hallucinogens:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Lysergic acids Diethylamide(LSD).

UNIT– IV

a) **Antisceptic and Disinfactants:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Potasiumpermangnate,

Hydrogen peroxide, Chlorhexidine, Cetrimide, ethanol, formaldehyde, glutaraldehyde, silver nitrate, silver sulfadiazine, gentian violet, acriflavine.

b) **Ectoparasiticides:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Benzyl benzoate, Lindane.

c) Principles of Toxicology and General Treatment of Poisioning

UNIT – V

Anti diabetic drugs and Insulin

Classification, Pharmacology, mode of action, adverse effects of Chlorpropamide (Glipizide, Gliclazide, Glimepiride), Metformin, Nateglinide, Rosiglitazone and Miglitol. Insulin and its mode of action