M.Sc. Industrial Chemistry  
Choice Based Credit System  
This course has Two Centric Electives of Specialization:  
1. Fine Chemicals (Group A) and 2. Pharmaceuticals (Group B)  
Four Semester Course  
Course Structure 2015-17

**SEMESTER I**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title of the Paper (s)</th>
<th>Course Type</th>
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<th>P</th>
<th>Total Credit</th>
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<td>IC-101</td>
<td>Analytical Chemistry</td>
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IC-109  Comprehensive Viva-voce  Virtual credit  4

Total Credits for First Semester: valid credits + virtual credits = 24

**SEMESTER II**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title of the Paper (s)</th>
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<td>IC-201</td>
<td>Chemistry of Natural Products</td>
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<td>IC-203</td>
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IC-209  Comprehensive Viva-voce  Virtual credit  4

Total Credits for Second Semester: valid credits + virtual credits = 24

**Signature: 21/7/15**
### SEMESTER III

<table>
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<tr>
<th>Course Code</th>
<th>Title of the Paper (s)</th>
<th>Course Type</th>
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Total Credits for Third Semester: valid credits + virtual credits = 24

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</table>

Total Credits for Fourth Semester: valid credits + virtual credits = 24

Minimum number of credits to be earned for award of Degree: 96
UNIT - 1

Data Analysis
Types of errors, propagation of errors, accuracy and precession, significant figures, least square analysis, average, standard deviation, t test, F test, Q 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, organic precipitation.

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, fundamentals of paper, thin layer, column and electrophoresis, ion chromatographic techniques. Application of these techniques in qualitative and quantitative analysis.
UNIT – 4

Gas Chromatography
Principles, theories, instrumentation and application of GSC and GLC, on line GC/Mass and GC/IR analysis.

HPLC
Principles, instrumentation and role of HPLC in qualitative and quantitative analysis, comparison of GC and HPLC. Application of LC/MS in analysis.

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. ICP-AAS.
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, Microemulsions, 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, treatment of unimolecular reactions. Dynamic chain (hydrogen bromine reaction, pyrolysis of acetaldehyde), photochemical (hydrogen – bromine, hydrogen chlorine reactions) and oscillatory reactions homogeneous catalysis, kinetics of enzyme-catalyzed reactions, study of fast reactions, by stop flow method, relaxation method, flash photolysis and the NMR method. 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, pickling, mechanical preparation of surfaces, cleaning, rinsing, electroplating equipment and operating conditions, characteristics of electroplating wastes, batteries.

UNIT – V

Ionic Equilibria
The Ostwald’s Dilution Law; concept of acids and bases; hard soft acids and basis; 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.
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_e1. 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_N1 mechanism. The neighbouring group participation of Π 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 electrophiles, 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 E₂, E₁ and E₃CB 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
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, acid mordant, direct milling and stilbene azo dyes, Basic dyes Anthraquinone (Vat) 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, and emulsion paints water based paints & 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, weatherometers.
UNIT – I
Carbohydrates
monosaccharide, Disaccharide and polysaccharide.
Cyclic structure of glucose, Glycolysis, TCA cycle & its regulation & oxidation of pyruvate to acetyl CoA
Glyoxylylate cycle, 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
Chemical kinetics and mechanism of enzyme – substrate complex
Factors governing enzyme activity & Isozymes & inhibition of enzymes
General structure of nucleic acid.

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.
## SYLLABUS OF PRACTICALS
**(M.Sc. Industrial Chemistry)**

### M.Sc. Industrial Chemistry-I Sem

**Lab Course – I Code: IC-105**

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

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<tr>
<th>General experiments (Minor)</th>
<th>1</th>
<th>To prepare molar and normal solutions.</th>
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<tr>
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<td>2</td>
<td>To prepare percent solution of given compound.</td>
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<td></td>
<td>3</td>
<td>To determine the strength of given solution of NaOH with N/10 oxalic acid.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Determination of total acidity of given sample of water.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Determination of total alkalinity of given sample of water.</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Determination of free CO₂ in a given sample of water.</td>
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<tr>
<td></td>
<td>7</td>
<td>To determine total hardness of given H₂O sample by complexometric method.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volumetric analysis (Major)</th>
<th>8</th>
<th>To standardize NaOH solution using oxalic acid solution and determine the strength of given HCl solution with standard NaOH solution.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>9</td>
<td>To determine the strength of given K₂Cr₂O₇ solution with N/10 sodium thiosulfate solution.</td>
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<tr>
<td></td>
<td>10</td>
<td>Find out volumetrically the amount/lit. of FeSO₄(NH₄)SO₄.6H₂O present in solution acidified with H₂SO₄.</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Determination of Temporary and Permanent Hardness of given sample of water.</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>To determine the Ca²⁺ and Mg²⁺ hardness of given water sample.</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>To determine the strength of a given CuSO₄ solution with N/20 sodium thiosulphate solution.</td>
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<td>14</td>
<td>Determination of chloride content of a water sample by Mohr’s method.</td>
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*Note: The page contains handwritten notes at the bottom.*
**M.Sc. Industrial Chemistry-I Sem**

**Lab Course – II Code: IC-106**

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

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<th>General experiments</th>
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<tr>
<td>1</td>
<td>Purification and distillation of tap water.</td>
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<tr>
<td>2</td>
<td>To determine the moisture content of a given sample by oven heating method.</td>
</tr>
<tr>
<td>3</td>
<td>Preparation of rose water by simple distillation.</td>
</tr>
<tr>
<td>4</td>
<td>Preparation of urea formaldehyde resin.</td>
</tr>
<tr>
<td>5</td>
<td>Preparation of phenol formaldehyde resin.</td>
</tr>
<tr>
<td>6</td>
<td>Determine the degree of hydrolysis and hydrolysis constant of CH₃COONa.</td>
</tr>
<tr>
<td>7</td>
<td>To determine the total alkalinity in a given sample of water using std. sulphuric acid.</td>
</tr>
<tr>
<td>8</td>
<td>To determine the adsorption isotherm of acetic acid by activated charcoal.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Chromatography</th>
<th>Description</th>
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<tbody>
<tr>
<td>9</td>
<td>To separate the given amino acid mixture by paper chromatography.</td>
</tr>
<tr>
<td>10</td>
<td>To separate the methyl orange and phenolphthalein by paper chromatography.</td>
</tr>
<tr>
<td>11</td>
<td>Separation of mixture of amino acids by thin layer chromatography.</td>
</tr>
<tr>
<td>12</td>
<td>To separate a given ink mixture with the help of column chromatography.</td>
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</table>
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, halitropropin, 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.
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

UNIT – III
Pericyclic Reactions
Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 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. Cycloadditions – antarafacial and suprafacial additions, 4n, 4n+2 systems, 1,3 dipolar cycloaddition. Sigmatropic rearrangements – suprafacial and antarafacial shift of “H”, sigmatropic shifts involving carbon moieties 3,3 and 5,5 sigmatropic rearrangements. Claisen,cope and aza – cope rearrangements.

Photochemistry
Cis-trans isomerization, Paterno – Buchi reaction, norrish typr –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$_4$, iodobenzene diacetate etc.

UNIT - V

Reduction
UNIT – I

Reagents in organic synthesis
Complex metal hydrides, Gilman’s reagents, lithium dimethyl cuprate, lithium disopropylamide, dicyclohexyle carbodimide 1,3 dithiane, tri methyl silyliodide, tri-n-butyl tin hydride, DDQ, Phase transfer catalyst, crown ethers, Merrifield resin, Wilkinson’s catalyst, Baker’s yeast.

UNIT – II

Heterocyclic Chemistry
Synthesis and reactivity of furan, Thiophene, pyrrole, pyridine, Quinoline, Isoquinilone and indole skraup synthesis, Fiesher indole synthesis.

UNIT – III

Molecular Rearrangement
Pinacol/Pinecolone rearrangement, Wagner-mercien rearrangement, wolff, hoffman, curtius, lossen, Schmidt, Backman, Favorskin, Jacobsom, Aston, Fries, Claisen, Shapiro.

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

UNIT – IV

Organic Reactions
Aldol, Perkin, Stobbe, Rieckmann condensation, Reimer- Tiemann, Reformatsky, Diels-Alder, Robinson annulation, Favorskin, Stork-enamine reaction, Michael, Aldrich, 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 1,3 dioxygenated skeletons, preparation of β-hydroxycarbonyl compounds, disconnection and synthesis of acyclic and cyclic hetero compounds.
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.

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-sulphur vulcanization, ebonite latex technology some major rubber products. Polymer industries in India.

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.


d) Adverse drug effects.

UNIT - II

Antipyretics analgesics

a) Some common antipyretic drug: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of paracetamol, acetanilide, aspirin, cinchophen, phenazine, mefenamic acid

b) Opioid analgesic or Narcotic analgesic drugs: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Morphene sulphate, codeine, levorphanon tartrate, metazocine, pethidine hydrochloride.

c) Non steroidal anti 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 and structure activity relationship of Cyclophosphamide, Melphalan, Busulfan, Methotrexate.

**UNIT - IV**

**Antibiotics**

a) **β-Lactam antibiotics:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Penicilline (Benzyl penicilline, cloxacillin, ampicilline) 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) **Antitubercular Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Isoniazid, Rifampin, Streptomycin.

b) **Antileprotic Drugs:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Dapsone, Clofazimine, Rifampin.
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 Mtronidazole, Diloxanide Furoate, Sodium stibogluconate, Pentamidine.
## M.Sc. Industrial Chemistry-II Sem

### Lab Course – I Code: IC-205

- **Organic synthesis:**
  - Major: 25
  - Minor: 20
  - Practical record: 05
  - Viva Voce: 10
  - Internal Assessment: 40

<table>
<thead>
<tr>
<th>No.</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To synthesize benzanilide from aniline.</td>
</tr>
<tr>
<td>2</td>
<td>To synthesize benzoic acid from benzanilide.</td>
</tr>
<tr>
<td>3</td>
<td>To prepare phthalimide from phthalic anhydride.</td>
</tr>
<tr>
<td>4</td>
<td>To synthesize 2,4,6-tribromoaniline from aniline.</td>
</tr>
<tr>
<td>5</td>
<td>To prepare p-nitroacetanilide from acetanilide.</td>
</tr>
<tr>
<td>6</td>
<td>To prepare methyl orange from sulphanilic acid.</td>
</tr>
<tr>
<td>7</td>
<td>To prepare phenyl azo β-naphthol from aniline.</td>
</tr>
<tr>
<td>8</td>
<td>To prepare β-naphthyl benzoate from β-naphthol.</td>
</tr>
<tr>
<td>9</td>
<td>To prepare p-iodoacetanilide from acetanilide.</td>
</tr>
<tr>
<td>10</td>
<td>To synthesize phenyl benzoate from phenol.</td>
</tr>
<tr>
<td>11</td>
<td>To synthesize diorgano ditelluride using Grignard reagent.</td>
</tr>
<tr>
<td>12</td>
<td>To synthesize diorgano diselenide using Grignard reagent.</td>
</tr>
</tbody>
</table>
M.Sc. Industrial Chemistry-II Sem
Lab Course – II Code: IC-206

- Natural products isolation:
  - Major: 25
  - Minor: 20
  - Practical record: 05
  - Viva Voce: 10
  - Internal Assessment: 40

<table>
<thead>
<tr>
<th>Natural products isolation</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To isolate cellulose from cotton.</td>
</tr>
<tr>
<td>2</td>
<td>To isolate β-carotene from carrot.</td>
</tr>
<tr>
<td>3</td>
<td>To isolate lycopene from tomato.</td>
</tr>
<tr>
<td>4</td>
<td>To prepare glucose from cane sugar.</td>
</tr>
<tr>
<td>5</td>
<td>To isolate caffeine from tea leaves.</td>
</tr>
<tr>
<td>6</td>
<td>To extract oleoresin from red chili.</td>
</tr>
<tr>
<td>7</td>
<td>To extract clove oil from clove buds through distillation and characterization by melting point, TLC and density.</td>
</tr>
<tr>
<td>8</td>
<td>To isolate casein from milk.</td>
</tr>
</tbody>
</table>
IC 301 - SPECTROSCOPY

UNIT – I

UV-visible Spectroscopy

Photo electron spectroscopy
General theory and application of UV and X-Ray photo electron spectroscopy (UV PES and ESCA) a general idea of auger photoelectron spectroscopy, application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

UNIT – II

Infrared Spectroscopy
Theory, vibration modes, instrumentation (Dispersive and non dispersive instrument), applications and interpretation of spectra
Brief idea of Raman Spectroscopy

UNIT – III

Nuclear Magnetic Resonance Spectroscopy
Theory of NMR, Chemical Shift, Spin-spin splitting, environmental effect on NMR spectra. Instrumentation, CW or FTNMR instrument, rules governing the interpretation of H$^1$ NMR spectra. Application in quantitative analysis, spectroscopy of others important nuclei. $^{15}$N, $^{19}$F, $^{29}$Si, $^{31}$P

$^{13}$C NMR : Historical Development, various terms used in C$^{13}$ NMR, application of C$^{13}$ NMR to structure determination, two dimensional NMR spectroscopy, principle, the COSY experiment, COSY (DQF) and NOESY experiment, three dimensional NMR experiment
UNIT – IV

Concept, instrumentation & use of ESR spectroscopy, ENDOR, ELDOR
NQR: Theory, Instrumentation & application of nuclear quadrupole resonance spectroscopy.

UNIT – V

Mass Spectroscopy

Massbaur (Fe & Sn)
General theory, instrumentation and important applications of Massbaur Spectroscopy.
IC 302 - UNIT OPERATIONS

UNIT – I

Distillation
Introduction; VLE, Batch and continuous distillation, Mecabe, Thiele method, 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, draft tube crystallizer.

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

Filtration

Size Reduction and size Separation
Definition, objectives of size reduction, factors affecting size reduction, Law governing energy and power requirement of mills including ball mill, hammer mill, fluid energy mill etc.

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

UNIT – V

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

Ideal Reactors
Performance equation for ideal CSTR & PFR, Batch reactor, Reactor fundamentals, Constant and Variable volume Batch reactor.
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, rehological 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, Fiber-spinning, injection moulding, thermoforming

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

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Fillers


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

Reinforcing and extending filler: Introduction manufactures characteristics and application of some representative fillers.

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, Antiemetics and other Gastrointestinal drugs.

(c) Drugs for constipation and Diarrhoea: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship 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: Growth factors, minerals, anticoagulants, thrombolytic and antiplatelet drugs

UNIT - III

Drugs acting on Kidney

a) Relevant physiology of urine formation

b) Diuretics: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Chloromerodrin, Hydrochlorothiazide, Acetazolamide, Chlorthalidona, Furosemide, Spironolactone, Mannitol.

c) Antidiuretics: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Lypressin, Amiloride, Carbamazepine.
UNIT - IV

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

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

(c) Treatment of drug allergies

UNIT - V

a) **Drugs acting on skins and mucous membrane:** Demulcients (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, Pyrethrroids, allethrin.
**Fungicides:** Dichlone, captan

UNIT - II
Structure, synthesis, mode of action, application & environmental impact of following:
**Chlorinated hydrocarbon:** BHC, heptachlor, aldrin, dieldrin, endosulfar, SAR in the class.

UNIT - III
Structure, synthesis, mode of action, application & environmental impact of following:
**Organo Phosphorous insecticides:** Dichlorovos, Paraoxon, SAR in the class
**Dithio phosphoric acid derivatives:** Malathion,
**Thio phosphoric acid:** Parathion, demeton, 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.
UNIT - I
The design of dosage forms and Preformulation

a) Design of Dosages Forms: Principles of dosage form design, biopharmaceuticals consideration in dosage form design, routes of drug administration, drugs factors in dosage form design, therapeutics 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) Viscosity, 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 bioavailability.

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.


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.
M.Sc. Industrial Chemistry-III Sem
Lab Course –I Code: IC-305

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

<table>
<thead>
<tr>
<th>Minor experiments</th>
<th>1</th>
<th>Determination of acidity of water sample.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Determination of acid value of oil.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>To determine density of given liquid with respect to water using pyknometer/RD bottle.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>To determine the relative viscosity of given liquid with respect to water by Ostwald’s viscometer.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>To determine surface tension of given liquid by stalgmometer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Major experiments</th>
<th>6</th>
<th>To prepare buffer standardization of pH meter and determine the molarity of HCl pH-metrically provided M/10 NaOH.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>To verify Beer Lambert’s law with the help of colorimeter and find out the concentration of unknown solution.</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>To determine the turbidity of given unknown solution using Nephlo-turbidimeter.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Determination of total alkalinity of given sample of water.</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>To determine the Ca$^{2+}$ and Mg$^{2+}$ hardness of given water sample.</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>To determine total hardness of given H$_2$O sample by complexometric method.</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Determination of Temporary and Permanent Hardness of given sample of water.</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Determination of free CO$_2$ in a given sample of water.</td>
</tr>
</tbody>
</table>
### M.Sc. Industrial Chemistry-III Sem

**Lab Course –II Code: IC-306**

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

<table>
<thead>
<tr>
<th>Quality assurance of drugs</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To determine hardness of given caplet.</td>
</tr>
<tr>
<td>2</td>
<td>To determine the bulk density of given powder.</td>
</tr>
<tr>
<td>3</td>
<td>To determine friability of given caplet and tablet.</td>
</tr>
<tr>
<td>4</td>
<td>To determine % dissolution of given caplet and tablet.</td>
</tr>
<tr>
<td>5</td>
<td>To determine the disintegration of given tablet and caplet.</td>
</tr>
<tr>
<td>6</td>
<td>To determine the amount of acetic acid and present in a given sample of vinegar.</td>
</tr>
<tr>
<td>7</td>
<td>To prepare alumina from potash alum.</td>
</tr>
<tr>
<td>8</td>
<td>To prepare Di-nitro methylene tetra amine (DNPT) from hexamine</td>
</tr>
<tr>
<td>9</td>
<td>To prepare Calcium Stearate from stearic acid.</td>
</tr>
<tr>
<td>10</td>
<td>To analyse the Antacid Tablets provided to you.</td>
</tr>
<tr>
<td>11</td>
<td>To prepare Aloe Vera gel.</td>
</tr>
<tr>
<td>12</td>
<td>To determine the Acidity of the fruit provided to you.</td>
</tr>
</tbody>
</table>
IC 401 - IPR, TQM & TECHNOLOGY MANAGEMENT

UNIT – I

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, recent changes in IPR and brief idea about various patent policies and practices.

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), GPC, 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. Organization for technology at enterprise level

33
UNIT – I

Thermoanalytical Methods: thermogravimetry, factors affecting thermogravimetric curves, derivative thermogravimetry (DTG), thermobalance. Applications of thermogravimetry, differential thermal analysis, factors affecting DTA curves, instrumentation, application of DTA.
Differential 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 potential coulometry.
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


UNIT – IV

Refractrometry, Polarimetry, Fluorescence and Phosphorance spectrometry. Optical Rotaty dispersion (ORD) and circular dichroism (CD) theory, instrumentation and application of above techniques.

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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
UNIT – I


UNIT – II


UNIT – III


UNIT – IV


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

UNIT – V

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

IC 404 A - PETROCHEMICALS, OILS & SOAPS

UNIT – I

Petrochemicals: Constituents of Petroleum, Processing or Refining, Petrochemicals, Feedstock’s, Petrochemicals from methane, ethylene, propylene, butylene and cyclic ring. Manufacture of petrochemical by chemical conversion.

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, Titer, Rosin value, Total fatty matter.

UNIT – IV


UNIT – V

IC 404 B - MEDICINAL CHEMISTRY – III

UNIT– I

Drugs acting on CNS:

(a) Introduction, site and mechanism of action of some neurotransmitters
NA, Dopamine, 5H.T., acetyl choline, GABA, Histamine.

(b) **General and Local anaesthetics.** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Ether, Halothane, Nitrous Oxide, Chloroform, Thiopentone sodium, Ketamine hydrochloride, Lignocaine hydrochloride, cinchocaine, phenacainic HCl, 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 (Diazepam, buspirone) and alcoholic hypnotics (Ethyl Alcohol, methylparafynol, Ethchlorvynol)

b) **Tranquilizers or Antianxiety Agents:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Reserpine, 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, 9A Tetrahydrocannabinol.
UNIT- IV

a) **Antiseptic and Disinfectants:** Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Potassium permanganate, Hydrogen peroxide, Chlorhexidine, Cetrime, 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 Poisoning

UNIT – V

**DRUG DESIGN**

a) **A rational approach:** Analogues and prodrugs, concepts of lead, factors governing drug design, rational approach of drug design, research and development strategies, tailoring of drugs.

b) **Physical – Chemical factors and biological activities:** Physical properties, factor governing ability of drugs to reach active site, dissociation constants, isoterism and bio-isoterism.

[Signature and dates]
M.Sc. Industrial Chemistry
Semester-IV
Industrial Training Code: IC-405
Term-end Examination: 60
Internal Assessment: 40

M.Sc. Industrial Chemistry
Semester-IV
Project Viva Code: IC-406
Term-end Examination: 60
Internal Assessment: 40

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21/7/15