DEEN DAYAL UPADHYAYA GORAKHPUR UNIVERSITY

GORAKHPUR

M.SC. INDUSTRIAL CHEMISTRY PROGRAMME

Department of Chemistry

(w.e.f Academic Session 2024 onwards)

Syllabus-M.Sc. Industrial Chemistry Programme

(w.e.f Academic Session-2024 onwards)

Course Structure (Two Year PG Programme-2024) Total Credits- 92

The following are the papers in M.Sc. Industrial Chemistry Programme:

SEMESTER I (4 theories+1 Practical of 4 credits each)

Course Code	Course Name	Credit	Theory/Practical
IC-501N	Physical Chemistry	4+0	**Theory-1**
IC-502N	Inorganic Chemistry-I	4+0	**Theory-2**
IC-503N	Organic Chemistry-I	4+0	**Theory-3**
IC-504N	Basics of Medicinal Chemistry	4+0	**Theory-4** (Choose any one)
IC-505N	Introduction to Polymeric Materials	4+0	
IC-506N	Quality Control and Industrial Hazards	4+0	
IC-507N	Unit Operations and Process Utilities	4+0	
IC-508N	Practical	0+4	**Practical**
	Total	**20**	

SEMESTER II (4 theories+1 Practical and 1 open elective of 4 credits each)

Course Code	Courses	Credit	Theory/Practical
IC-509N	Analytical Chemistry-I	4+0	**Theory-1**
IC-510N	Inorganic Chemistry-II	4+0	**Theory-2**
IC-511N	Organic Chemistry-II	4+0	**Theory-3**
IC-512N	Medicinal Chemistry-I	4+0	**Theory-4** (Choose any one)
IC-513N	Polymer Science-I	4+0	
IC-514N	Agrochemicals and Organic Fertilizers	4+0	
IC-515N	Petrochemicals, Oils & Soaps	4+0	
IC-516N	Practical	0+4	**Practical**
IC-517N	Good Laboratory Practices & Industrial Hygiene	4+0	**Open Elective#** (Choose any one)
IC-518N	Environmental Chemistry		
	Total	**24**	

any one of these paper for other PG Programmes

SEMESTER III (4 theories+1 Practical and 1 research project of 4 credits each)			
Course Code	**Courses**	**Credit**	**Theory/ Practical**
IC-519N	Analytical Chemistry-II	4+0	**Theory-1**
IC-520N	Characterization Techniques-I	4+0	**Theory-2**
IC-521N	Introduction to Smart Materials	4+0	**Theory-3**
IC-522N	Medicinal Chemistry-II	4+0	**Theory-4** (Choose any one)
IC-523N	Polymer Science-II	4+0	
IC-524N	CNS Drugs	4+0	
IC-525N	Paints & Pigments	4+0	
IC-526N	IPR & Technology Management	4+0	
IC-527N	Practical	0+4	**Practical**
IC-528N	Research Project	0+4	**Research Project**
	Total	**24**	

SEMESTER IV (4 theories+1 Practical and 1 research project of 4 credits each)			
Course Code	**Courses**	**Credit**	**Theory/ Practical**
IC-529N	Characterization Techniques-II	4+0	**Theory-1**
IC-530N	Pulp & Paper Technology	4+0	**Theory-2**
IC-531N	Industrial Values & Working Ethics	4+0	**Theory-3**
IC-532N	Polymer Chemistry	4+0	**Theory-4** (Choose any one)
IC-533N	Inorganic Materials	4+0	
IC-534N	Drugs and Agrochemicals	4+0	
IC-535N	Solid State Chemistry	4+0	
IC-536N	Nuclear and Radiation Chemistry	4+0	
IC-537N	Biophysical Chemistry	4+0	
IC-538N	Computational Chemistry	4+0	
IC-539N	Practical	0+4	**Practical**
IC-540N	Research Project	0+4	**Research Project**
	Total	**24**	

Semester-I

IC-501N: Physical Chemistry

Unit-1

Surface Chemistry and Interfacial Phenomenon

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

Unit-2

Catalysis

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

Unit-3

Electro Chemistry

Standard electrode potential, galvanic series, galvanic cells, concentration cells, polarization,

Corrosion: classification of corrosion, corrosion reactions, factors affecting corrosion,protection from corrosion.

Unit-4

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

Recommended Text Books

1. Electrochemistry by S. Glasstone

2. Electrochemistry by Potter

3. Modern Electrochemistry by Bockris Reddy VoL I&II

4. Comprehensive Physical Chemistry by N.B. Singh, S.S. Das and N.S. Gajbhiye, New Age International Publishers.

IC-502N: Inorganic Chemistry-I

Unit-1

Shapes of molecules: VSEPR theory and hybridization; Coordination Chemistry: Crystal field theory, Jahn-Tellar theorem, Spectrochemical series.

Unit-2

Molecular orbital theory, Magnetic Properties, Nephelauxetic series, L-S & j-j coupling scheme, Terms and Microstates, Orgel and TS diagrams, Electronic spectra of metal complexes.

Unit-3

Stability constants of metal complexes, Inorganic Reaction Mechanisms, Hydrolysis Reactions, Trans Effect, Electron Transfer Reactions, Carbonyls and Metallocenes.

Unit-4

Bioinorganic Chemistry: Iron Sulfur Clusters, Porphyrins and Corrins, Metal-Nucleotide Complexes, Dioxygen Binding, Photosynthesis; Metallo-Enzymes: Model Compounds.

Recommended Text Books

1. Inorganic Chemistry, 4th Edition, Principles of Structure and Reactivity by J.F. Huheey, E.A. Keiter and R.L. Keiter, 1993

2. Chemistry of Elements by N.N. Greenwood and A. Ernshaw, Butterworths, 1997

3. Mechanism of Inorganic Reactions; A Study Of Metal Complexes in Solution by F. Bosolo and R.G. Pearson

4. Organometallic Chemistry: A Unified Approach by R.C. Mehrotra and A.K. Singh

IC-503N: Organic Chemistry-I

Unit-1

Reaction Mechanism

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

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

Unit-2

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

Unit-3

Aliphatic Electrophilic Substitution

Bimolecalar mechanism - SE^2, SE^i. The SE^1 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. Ipsoattack.

Unit-4

Aliphatic Nucleophilic Substitution

The SN^2, SN^1, mixed SN^1 and SN^2 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.

Recommended Text Books

1. Advanced Organic Chemistry Part. A & B By F. A. Carey and R. J. Sundberg, Plenum Publisher, New York, 2007.

2. Advanced Organic Chemistry By J. March, 2007.

3. Organic chemistry By J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford University Press , New York, 2001.

IC-504N: Basics of Medicinal Chemistry

Unit-1

General Pharmacological Principles

a) 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.

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

d) Adverse drug effects.

Unit-2

Antipyretics analgesics

a) Some common antipyretic drug: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of paracetamol, acetanilide, asprin, mefenanic acid

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

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

Unit-3

a) Sulphonamides: Classification, phannacology, 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.

Unit-4

Anti Cancer Drugs: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Cyclophosphamide, Melphalan, Busulfan, Methotrexate.

Recommended Text Books

1. An Introduction to Medicinal Chemistry by Graham L. Patrick.
2. Textbook of Organic Medicinal and Pharmaceutical Chemistry by Charles O. Wilson, Ole Gisvold & Robert F. Doerge.
3. Principles of Medicinal Chemistry by William O. Foye, Thomas L. Lemice and David A. Williams.
4. Burgers Medicinal Chemistry and Drug Discovery by M.E. Wolff.

IC-505N: Introduction to Polymeric Materials

Unit-1

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-2

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, solution, emulsion and suspension polymerizations, Advantages and disadvantages of the techniques and of the products from them.

Unit-3

Molecular mass

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

Unit-4

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

Recommended Text Books

1. Text Books of Polymer Science : F.W. Billmayer Jr.
2. Physical Chemistry : P.W. Atkins (ELBS)

IC-506N: Quality Control and Industrial Hazards

Unit 1

Statistical Quality Control Techniques: Statistical treatment of data. Control charts, Performance Evaluation uncertainties in measurement. Validation of analytical methods.

Unit 2

Quality Assurance: Elements of quality Assurance, Quality Management System Quality management concepts and principles: ISO 9001:2000 QMS Case studies on ISO 9001: 2000 in chemical industries. ISO 14000 Series of Standards. TQM in Chemical Industry. Six Sigma Approach to Quality: Applying Six Sigma to chemical Industries. Accreditation of QC laboratories: Tools and Mechanisms ICH Guidelines on Drug substances and Products.

Unit 3

Industrial hazards and Safety: Process hazards checklists, hazard surveys, safety program, Hazop safety reviews.

Industrial pollution: Classification of hazards chemicals, storage, transportation, handling, risk assessments, challenges/solutions.

Unit 4

Eco-friendly effluents disposal: Water pollutants, health hazards, sampling andanalysis of water, water treatment, different industrial and domestic effluentsand their treatment and disposal, advanced waste water treatment, effluentquality standards and laws, chemical industries, tannery, dairy, textile effluents,common treatment.

Recommended Text Books

1. Industrial Safety Management: Hazard Identification and Risk Control by L.M. Deshmukh.
2. Industrial Safety, Health & Environment Management Systems by R.K. Jain & S. S. Rao.

IC-507N: Unit Operations and Process Utilities

Unit 1

Distillation: Basic Principles and Applications, Flash operation, Continuous distillation, Batch Distillation, McCabe Thiele method, Plate efficiency.

Multi component Distillation: Phase equilibrium with multi component distillation, flash distillation of multi component mixtures.

Unit 2

Leaching and Extraction: Leaching, Principles of continuous countercurrent leaching, Liquid Extraction, principles of extraction.

Gas Absorption: Principle of Absorption, Rate of absorption, Design of Packed towers.

Adsorption: Adsorption equipment, Adsorption Isotherms, Principle of Adsorption, Design of equipments.

Unit 3

Evaporation: Introduction and Basic principle, Equipments, Short tube (standard) Evaporator, Forced circulation evaporators, Falling film evaporators, Climbing film (upward flow) evaporators, Wiped (agitated) film evaporator.

Drying: Introduction, Free moisture, Bound moisture. Drying curve, Drying equipments.

Crystallization: Introduction, Solubility, Super saturation, Nucleation, Crystal growth, Crystallization Equipments.

Unit 4

Process Utilities in Chemical industries

Water: Specification of Industrial use, Various Water Treatment methods.

Air: Specification of Industrial use, Processing of air.

Steam: Generation and Industrial Use.

Boilers: Types of boilers and their functioning.

Recommended Text Books

1. McCabe, W.L., Smith, Julian C. & Harriett, Peter, "Unit Operations of Chemical Engineering", McGraw Hill, New Delhi, 7/e, 2005.

2. Geankoplis, Christie J., "Transport Processes and Unit Operations", Prentice Hall of India, New Delhi, 3/e, 1997

3. Max S. Peters, Klaus D. Timmerhaus and Ronal E. West, Plant Design and Economics for Chemical Engineers, McGraw-Hill, New York.

Semester-I

IC-508N: Practical

Marks (Practical): 100; Time: 8 h in two days;

Marks distribution (Practical)

Practical: 75 marks

Internal Assessment: 25 marks

Experiments

1. Analysis of primary binary organic mixture (Liquid-Liquid, Liquid-Solid, Solid-Solid)
2. Determination of equivalent weight of organic acids by direct titration method
3. To determine the strength of given solution of NaOH with N/10 oxalic acid.
4. Spot test for the detection of inorganic ions (any ten cations)
5. Determination of heavy metals in industrial waste water
6. Determine the degree of hydrolysis and hydrolysis constant of CH_3COONa.
7. To determine the adsorption isotherm of acetic acid by activated charcoal.
8. To determine surface tension of given liquid by stalagmometer.
9. To determine the moisture content of a given sample by oven heating method.
10. Preparation of rose water by simple distillation.
11. Preparation of urea formaldehyde resin.
12. Preparation of phenol formaldehyde resin.
13. Estimation of sulphur in organic compounds
14. Batch sedimentation test.
15. Solid-Liquid Extraction of oil from oil seeds
16. Rate of dehydration of vegetable products.
17. Extraction of essential oil
18. Solid-liquid extraction
19. Liquid-liquid extraction
20. To determine the relative viscosity of given liquid with respect to water by Ostwald's viscometer.

Semester-II

IC-509N: Analytical Chemistry-I

Unit-1

Data Analysis

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

Unit-2

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-3

Gravimetric Methods of Analysis

Principles of gravimetric analysis, formation and properties of precipitates, appli cations of gravimetric analysis, organic precipitation.

Unit-4

Solvent Extraction

Theoretical principle, classification, factors favouring extraction, extraction equilibrium,

Instrumentation and application.

Recommended Text Books

1. Fundamentals of Analytical Chemistry: D.A. Skoog, D.M. West and F.J. Holler, 1992, 6e

2. Quantitative Inorganic Analysis, A.I. Vogel, 2012, 7e

3. Instrumental Methods of Chemical Analysis: B.K. Sharma, 2011

4. Instrumental Methods of Chemical Analysis: H. Kaur, 2016, 12 e

5. Analytical Chemistry, Gary D. Christian, 2007, 6e

6. Instrumental Methods of Analysis: H.H. Willard, L.L. Merrit, Jr. J.A. Dean, 1974, 5e

IC-510N: Inorganic Chemistry-II

Unit-1

Organometallic chemistry and catalysis in industry: Industrial applications of organotransition metal compounds; Important catalytic reactions: Hydrogenation, Wacker process, Ziegler-Natta catalysis;

Unit-2

Metal carbonyls compounds; Organometallic reagents in organic synthesis: Principle, preparation and applications of Li, Mg, Hg, Zn, Ni, Pd, Fe, Co and boron compounds in organic synthesis; Medicinal application of organometallic chemistry.

Unit-3

Synthetic methods for inorganic materials such as dry and wet method, sol-gel method.

Unit-4

Metals & Metallurgy

Basic concept and process involved e.g. iron, aluminium, copper, nickel

Recommended Text Books

1. Comprehensive Organometallic Chemistry, Ed. E.W. Abel, Abel, F.G.A. Stone and G. Wilkinson, Pergamon, 1982.

2. Advnaced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, `Wiley, 1999.

3. The chemistry of elements, N.N. Greenwood and A. Earnshaw, 1997.

4. Inorganic Chemistry, principles of structure and reactivity. J.E. Huheey, Harper, 1983.

5. Organometallic Chemistry (A unified approach), R.C. Mehrotra and A. Singh, Wiley Eastern, 1991.

6. Industrial Chemistry by B.K. Sharma.

7. Industrial Chemistry by P.C. Jain and Monika Jain.

IC-511N: Organic Chemistry-II

Unit-1

Addition to carbon - carbon multiple bond

Mechanistic and stereochemical aspects of addition reactions involving elecrophiles,nucleophiles and free radicals.

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. Addition of Grignard reagents, organozinc and organolithiumreagents to carbonyl compounds, Wittig reaction.

Unit-2

Elimination Reactions

The E2, E1 and E_1CB mechanism and their spectrum. Orientation of the double bond. Mechanism and orientation in Pyrolytic elimination.

Unit 3

Stereochemistry: Stereoselectivity, stereospecificity, conformational, optical isomerism, optical activity, classification of chiral molecules based on symmetry, molecular symmetry and asymmetry, geometrical isomerism.

Unit 4

Asymmetric synthesis. Retrosynthetic analysis. Application of symmetry in photochemistry and photochemical and pericyclic reactions.

Recommended Text Books

1. Stereochemistry of carbon compounds by E. L. Eliel, 1997.

2. Stereochemistry by P. S. Kalsi, 1997.

3. Stereochemistry of Organic compounds By D. Nasipuri, 1994.

IC-512N: Medicinal Chemistry-I

Unit-1

Antibiotics

a) β-Lactam antibiotics: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship 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.

Unit-2

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

b) Mecrolide Antibiotics: Classification, pharmacology, mode of action, adverse effects, synthesis and stmcture activity relationship of Erythromycin.

Unit-3

a) Antitubercular Drugs: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Isoniazid, Rifampin, Streptomycin.

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

Unit-4

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, Sucralfate.

(b) Emetics, Antiemetics and other Gastrointestinal drugs.

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

Recommended Text Books

Medicinal Chemistry by A. Burger, 2002

IC-513N: Polymer Science-I

Unit-1

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.

Unit-2

Phvsical & mechanical testing of Polymer: Stress-strain measurement, dynamic mechanical behaviour, stress cracking, hardness,tear strength or tear resistance, resilience's, flex cracking resistance, abrasionresistance, impact resistance.

Unit-3

Rubber

Materials and Processing Technology

Introduction, types, thermoplastic elastomers (TPE), compounding and processingtechnology, vulcanization of elastomers, theory and accelerator action of sulphur vulcanization, non-sulphervalcanization, ebonite latex technology some major rubberproducts. Polymer industries in India.

Polymer degradation and stabilizers

Thermal degradation, photo degradation, Oxidative, degradation biological degradation, therole of antioxidants and stabilizers.

Unit-4

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

Recommended Text Books

1. F. W. Billmeyer, "Textbook of Polymer Science", John Wiley & Sons, New York.

2. H. R. Allcock, F. W. Lampe and J. E Mark, "Contemporary Polymer Chemistry", Pearson Education Prentice Hall, Singapore.

3. Charles E. Cariaher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc, New York.

4. U. R. Gowariker, N. V. Vishwanathan and J. Shreedhar, "Polymer Science", New Age International Publishers, New Delhi.

5. S. S. Das and N. B. Singh, An Introduction to Polymer Science and Technology", New age International Publishers, New Delhi.

IC514N: Agrochemicals and Organic Fertilisers

Unit-1

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

Insecticide of Plant Origin: Nicotine, Pyn!throids.

Fungicides: Dichlone, captan

Unit-2

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

Chlorinated hydrocarbon: aldrin, dieldrin, SAR in the class.

Unit-3

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, demetron, chlorthion,

Pyrophosphoric acid derivative: TEPP

Unit-4

Formulation of Pesticides

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

Liquid formulation: Emulsions, suspensions, aerosols and sprays.

Recommended Text Books

Medicinal Chemistry by A. Burger, 2002

IC-515N: Petrochemicals, Oils & Soaps

Unit-1

Petrochemicals: Constituents of Petroleum, Processing or Refining, Petrochemicals,Feedstock's, Petrochemicals from methane, ethylene, propylene, butylenes and cyclicring. Manufacture of petrochemical by chemical conversion.

Unit-2

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

Unit-3

Soaps and detergents: Cleaning agents, Soaps, manufacture of soaps, Glycerin, Methodsof production of glycerin, Detergents, manufacture of various kinds of detergents,cleaning action of soaps and detergents, Use Pattern, Saponification value, Acidvalues, Iodine value, Titer, Rosin value, Total fatty matter.

Unit-4

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

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

Recommended Text Books

1. Chemistry of Petrochemical Process, Sami Matar, Lewis F. Hatch, Gulf Professional Publishing. Boston.

2. Fundamental of Petroleum Chemical Technology, P. Belov, Mir Publications, Moscow.

3. Advanced Petroleum Refining, G. N. Sarkar, Khanna Publishers, Delhi.

4. Petrochemicals, Peter Wisheman, John Wiley & Sons, New York

5. Fundamentals of Petroleum and petrochemical Engineering, Uttam Rai Chaudhari, CRC Press, Taylor & Francis group

6. Organic chemistry, warren, oxford university press

Semester-II

IC-516N: Practical

Marks (Practical): 100; Time: 8 h in two days;

Marks distribution (Practical)

Practical: 75 marks

Internal Assessment: 25 marks

Experiments

1. Determination of Temporary and Permanent Hardness of given sample of water. To determine the Ca^{2+} and Mg^{2+} hardness of given water sample.
2. To determine the strength of a given $CuSO_4$ solution with N/20 sodium thiosulphate solution.
3. Determination of chloride content of a water sample by Mohr's method.
4. Estimation of the following metals in solution V, Cr, Mo, Fe and Ni.
5. To synthesize benzanilide from aniline.
6. To synthesize benzoic acid from benzanilide
7. To prepare phthalamide from phthalic anhydride.
8. To synthesize 2,4,6-tribromoaniline from aniline.
9. To prepare p-nitroacetanilide from acetanilide.
10. To prepare methyl orange from sulphanilic acid.
11. To prepare phenyl azo p-naphthol from aniline.
12. To prepare p-iodoacetanilide from acetanilide.
13. To synthesize phenyl benzoate from phenol.
14. To isolate cellulose from cotton.
15. To isolate p-carotene from carrot.
16. To isolate lycopene from tomato.
17. To isolate caffeine from tea leaves.
18. To extract oleoresin from red chili.
19. To extract clove oil from clove buds through distillation and characterization by melting point, TLC and density.
20. Conductometric titration between strong acid and strong alkali
21. pH measurement and pH titration of strong acid and strong base Study the adsorption of oxalic acid on charcoal and draw the Freundlich isotherm
22. Determination of plastic and dry properties of Ceramic Raw materials.
23. Estimation of moisture in powder/Raste/Cake etc.
24. Determination of specific gravity of material.
25. Determination of dry/green shrinkage of products/fabricated items.
26. Determination of compressive, Tensile strength and MOR of green pieces in proper shape.

(OPEN ELECTIVE)

IC-517N: Good Laboratory Practices & Industrial Hygiene

Unit 1

Introduction to GLP: Introduction, fundamentals and principles of GLP, GLP compliance & preparation for certification; ISO / IEC 17025: 2017 & Laboratory accreditation, Use of Computers in the laboratory, International GLP of the OECD, FDA etc, Laboratory demonstration, Practicals and Instrument handling.

Unit 2

Quality Control and Quality Assurances: Concept of Quality Control and Quality Assurance- Their functions and advantages, Documentation, records and preparation of SOPs and other Quality Management system records, Method Validation and Quality Assurance.

Unit 3

Industrial hygiene: Introduction, Physical, Chemical and biological Hazards, evaluation and control Toxicology, Routes of entry of toxic substances, Safe Housekeeping instrumentation for safe operation.

Unit 4

Industrial hygiene: Concept, air and biological monitoring, occupational disease,operational control measures, personal protective equipments.

(OPEN ELECTIVE)

IC-518N: Environmental Chemistry

Unit 1

Chemistry of Atmosphere: Composition and structure of atmosphere, Greenhouse effect, Ozone depletion, Photochemical smog,

Air Pollution: Air sampling techniques, Sources, effects and monitoring of air pollutants by Instrumental methods, Control of air pollution.

Unit 2

Water Pollution: Different types of water pollutants, Sources, characteristics and effects of water pollutants, Monitoring of Water Pollutants, Treatment of Municipal Waste Water, Treatment of Industrial Waste Water.

Unit 3

Environmental Impact Assessment: Process of Environmental Impact Assessment in India, Environmental Sustainability

Unit 4

Basic Principles of Green Chemistry.

Energy Harvesting and Source of Renewable Energy

Recommended Text Books

1. K. De, Environmental Chemistry, 4th Edn, New Age International (P) Ltd. Publications, New Delhi, 2000.

Semester-III

IC-519N: Analytical Chemistry-II

Unit-1

Ion Exchange Chromatography

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

Unit-2

Separation Techniques

Classification of chromatographic techniques, fundamentals of paper, thin layer and column chromatography, electrophoresis, ion chromatographic techniques. Application of these techniques inqualitative and quantitative analysis.

Unit-3

Gas Chromatography

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

Unit-4

HPLC

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

Recommended Text Books

1. Fundamentals of Analytical Chemistry: D.A. Skoog, D.M. West and F.J. Holler, 1992, 6e

2. Quantitative Inorganic Analysis, A.I. Vogel, 2012, 7e

3. Instrumental Methods of Chemical Analysis: B.K. Sharma, 2011

4. Instrumental Methods of Chemical Analysis: H. Kaur, 2016, 12 e

5. Analytical Chemistry, Gary D. Christian, 2007, 6e

6. Instrumental Methods of Analysis: H.H. Willard, L.L. Merrit, Jr. J.A. Dean, 1974, 5e

IC-520N: Characterization Techniques-I

Unit-1

UV-Visible Spectroscopy :

Different type of electronic transitions, Lambert-Beer's law, Chromophores, Auxochromes, Solvent effect, Red shift and blue shift, Woodward's rule for conjugated cyclic and acyclic dienes and α, β – unsaturated carbonyl compounds, Absorption in aromatic compounds (substituted benzene, naphthalene and anthracene), Problems related to UV-Visible Spectroscopy.

Unit-2

Infrared Spectroscopy:

Linear harmonic oscillator, Vibrational energies of diatomic molecules, Zero point energy, Force constant and bond strength, Anharmonicity, Morse potential energy diagram, Selection rules, Overtones, Hot bands, Absorption by common functional groups, Brief description of IR and FTI.R instruments, Problems related to IR Spectroscopy.

Unit-3

Raman Spectroscopy:

Theories of Raman Effect, Conditions of Raman active vibrations, Selection rules, Polarized and depolarized Raman lines, Study of: (a) Simple molecules such as SO_2, CO_2, N_2O and C_2H_2; (b) Hydrogen bonding and (c) Metal ions in solution, Mutual exclusion principle, Problems related to Raman Spectra and its interpretation.

Unit-4

Diffraction Methods for Structure Determination

a. X-ray Diffraction: Principle, elucidation of crystal structure of NaCl by X-ray diffraction, Structure factor, Methods for structure determination by trial and error methods, Fourier's method of analysis and Patterson's function method.
b. Electron diffraction: Principle, technique, scattering intensity versus scattering angle curves, Wierl equation, energy electron diffraction (LEED)
c. Neutron diffraction: Principle, technique and difference with electron diffraction

Unit-5:

Common problems related to above spectroscopic techniques

Reference Books

1. Fundamentals of Molecular Spectroscopy, 4th Ed. Mc Graw-Hill, C.N. Banwell
2. Basic Principles of spectroscopy, Mc Graw –Hill, R. Chang
3. Organic Spectroscopy, ELBS, W. Kemp
4. Modern Spectroscopy, Wiley, J.M. Hollas

IC-521N: Introduction to Smart Materials

Unit 1

Materials Science: Introduction, Atomic structure, Chemical bonding, Crystal structure, Properties; Mechanical, Thermal, Electrical, Magnetic.

Unit 2

Explosives: Definition, classification, synthesis and uses: nitrobenzene, TNT, PETN, picric acid, mono and ethylene glycol, glycol dinitrate, nitroglycerine,nitrocellulose, manitol, RDX, guanidine nitrate. Fire retardants: Definition,classification, synthesis and uses.

Unit 3

Optical and Electrical Materials

Unit 4

Sensors: Concept of molecular sensors its properties and applications

Recommended Text Books

1. Fundamentals of Smart Materials by M. Shahinpoor.
2. The Chemistry of Explosives by J. Akhavan.

IC-522N: Medicinal Chemistry-II

Unit 1

Cardiovascular drugs

a) Cardiovascular Drugs: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Digoxin, Digitoxin, Methyldopa, Nitroglycerine

Unit 2

Drugs acting on Kidney

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

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

Unit-3

(a) Drugs of Arthritis & Gout: Classification, pharmacology, mode of action,adverse effects, synthesis and structure activity, relationship of d-Penicillamine, Chloroquine.

(b) Drugs of Cough and Bronchial Asthama: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Codeine, dextromethorphan.

Unit-4

Drugs acting on skins and mucous membrane: Demulcents (Glycerine), Emollients (Vegetable Oils), Adsorbents and protectives (Calamine, Zinc Oxide), Astringents (Tannia acid, alcohol, minerals), Drugs of Psoriasis (Calcipotriol), Demelanizing Agents (Hydroquinone), Sunscreens, Drugs for acne vulgaris (Benzoyl peroxide).

Recommended Text Books

1. An Introduction to Medicinal Chemistry by Graham L. Patrick.
2. Textbook of Organic Medicinal and Pharmaceutical Chemistry by Charles O. Wilson, Ole Gisvold & Robert F. Doerge.
3. Principles of Medicinal Chemistry by William O. Foye, Thomas L. Lemice and David A. Williams.
4. Burgers Medicinal Chemistry and Drug Discovery by M.E. Wolff.

IC-523N: Polymer Science-II

Unit 1

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 2

Functions and example of compounding ingredients:

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

Fillers:

Carbon Black: Introduction manufacturer and morphology, Physical & chemicalproperties, 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.

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

Unit 3

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 4

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

Recommended Text Books

1. Fundamental principles of polymer materials practices for engineers, Plastics Materials, Stephen L. Rosen, Barnes & Noble, New York.

2. Plastics Materials, J. A. Brydson, Butterworths, London.

3. Polymer Technology, D.C. Miles & J. H. Briston, Chemical Publishing company, Inc, New York.

4. Plastics Materials and Processes, Seymour S. Schwartz S.H. Goodman, Van Nostrand Reinhold, New York.

5. Plastics Technology, R. V. Milbey, McGraw Hill, Book Company New York,

6. Polymer science and Technology of Plastics and Rubber, P. Ghosh, McGraw hill, New York.

7. Engineering Plastics, R.W. Dyson, Chapman & Hall, New York

IC-524N: CNS Drugs

Unit-1

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 Nitrous Oxide, Chloroform, cinchocaine, phenacainie hydrochloride..

Unit-2

a) Sedatives and hypnotics: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Barbiturates (Barbiton, Phenobarbital, Benzodiazepines (Diazepan,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-3

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

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

Unit-4

Antisceptic and Disinfactants: Classification, pharmacology, mode of action, adverse effects, synthesis and structure activity relationship of Potasium permangnate,Hydrogen peroxide, Chlorhexidine, glutaraldehyde, silver sulfadiazine, gentian violet, acriflavine.

Recommended Text Books

1. Handbook of pharmaceutical manufacturing, Edited by Shayne Cox Gad, Willey interscience, USA

2. Remington: The science and practice of pharmacy, 19th edition, A.R. Gennaro, Mack pub. Co.

3. Modern pharmaceutics, G.S.Banker, Informa healthcare.

4. Ansel's Pharmaceutical dosage forms and drug delivery systems, 8th edition, H. C. Ansel, Lippincott Williams and wilkins publisher

IC-525N: Paints & Pigments

Unit-1

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

Unit-2

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-3

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-4

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.

Recommended Text Books

1. Surface coating technology, Vol 1 & 2, OCCA, Chapman & Hall, London & New York

2. Paints & surface coatings, theory & practice, 2nd edition, R. Lambourne & T. A. Stevens, William Andrew Publishers.

3. Technology of printing inks, E. A. Apps

4. Protective Print coatings for metals, Fraun Hofer & Boxaln, Particullis Press, England Basics of Paint Technology, 1st edition, C. Malshe.

IC-526N: IPR & Technology Management

Unit 1

Basic concept & objective of IPR.

Unit 2

Types of IPR (Patents, Copyrights, Trademarks TM, Trade Secrets).

Unit 3

Basic concept of Technology management.

Unit 4

Role of IPR in technology advancement.

Semester-III

IC-527N: Practical

Marks (Practical): 100; Time: 8 h in two days;

Marks distribution (Practical)

Practical: 75 marks

Internal Assessment: 25 marks

1. To separate the given amino acid mixture by paper chromatography.
2. To separate the methyl orange and phenolphthalein by paper chromatography.
3. Separation of mixture of amino acids by thin layer chromatography.
4. To separate a given ink mixture with the help of column chromatography.
5. To isolate casein from milk.
6. Determination of moisture content by hot air oven and infra-red moisturometer:
7. Estimation of titrable acidity in the given food sample.
8. Determination of fat content of given soy flavour sample using soxhelt apparatus.
9. Estimation of protein content by Kjeldhal apparatus.
10. Determination of Vitamin C in the citrus fruit/juice/squash.
11. Multistep synthesis of organic compounds
12. Estimation of sulphur in organic compounds
13. Estimation of glycine
14. Purity of commercial benzoid acid by IR.
15. To determine hardness of given caplet.
16. To determine the bulk density of given powder.
17. To determine friability of given caplet and tablet.
18. To determine % dissolution of given caplet and tablet.
19. To determine the disintegration of given tablet and caplet.
20. To determine the amount of acetic acid and present in a given sample of vinegar.
21. To prepare alumina from potash alum.
22. To prepare Di-nitro methylene tetra amine (DNPT) from hexamine
23. To prepare Calcium Stearate from stearic acid.
24. To analyse the Antacid Tablets.

IC-528N: Research Project:

Under the research project, the student can conduct experiments, engage in review writing, perform lab work, or complete dissertation work related to the syllabus of a particular semester, all under the supervision of the assigned mentor.

SEMESTER-IV

IC-529N: Characterization Techniques-II

Unit-1

Mass Spectrometry

Measurement technique (El, Cl, FD and FAB), Molecular base and molecular ions, various class of organic molecules, McLafferty re-arrangement and retro-Diels-Alder Fragmentation, nitrogen rule and determination of molecular composition of organic compounds from mass spectra data.

Unit-2

^{1}H-NMR

The spinning nuclei, Chemical shift and its measurement, factors affecting chemical shifts, anisotropic effect and shielding mechanism, interpretation of protons spin-spin coupling, coupling constant, simple, virtual and complex coupling, Chemical and magnetic equivalence, NMR studies of other nuclei e.g., ^{19}F and ^{31}P, application in structural determination of simple organic and inorganic molecules.

Unit-3

^{13}C-NMR

General introduction, peak assignments, chemical shift, ^{13}C-^{1}H coupling, Off-resonance Decoupling, Deuterium, fluorine and phosphorus coupling, NOE and DEPT, 2D NMR, Application to simple organic and inorganic molecules.

Unit-4

Electron Spin Resonance Spectroscopy

Basic principle, factor affecting value, isotropic and anisotropic hyperfine coupling constant, Application to organic free radical, Methyl free radical, Naphthalene and Benzene free radicals, CID NP.

Unit-5

Mossobauer Spectroscopy

Theory, Instrumentation, Applications - isomer shift, nuclear quadrupole coupling and hyperfine interaction, Problems related toMossobauer Spectroscopy.

Reference Books:

1. Fundamentals of Molecular Spectroscopy, 4th Ed. Mc Graw-Hill, C.N. Banwell
2. Basic Principles of spectroscopy, Mc Graw –Hill, R. Chang
3. Organic Spectroscopy, ELBS, W. Kemp
4. Modern Spectroscopy, Wiley, J.M. Hollas

IC-530N: Pulp & Paper Technology

Unit 1

History of paper making, pulp and paper industry in India, future prospects, Raw materials for pulp industry, classification and properties of fibrous raw materials, fiber morphology and chemical composition of wood and grass species. Chemistry of wood lignin, cellulose, hemicellulose and extraneous components, reaction of wood constituents.

Unit 2

Preparation of raw material for pulping, general Principles of mechanical and chemical (acid, neutral and alkaline) pulping processes, continuous and batch digestion material and energy balances in a pulp mill, pulping kinetics.

Unit 3

Treatment of spent liquors and recovery of pulping chemicals and byproducts, pulp bleaching (single and multi-stage), new techniques in bleaching, bleaching sequence. Stock preparation, paper making and coating, modern paper machine, sizing, dying and wet strength additives. Air and steam pollution aspects.

Unit 4

Pulp and paper properties and testing, process instrumentation, Dissolving grade pulps, special papers, paper grades, lignin as a Chemical raw material. Introduction to modern pulping technology advances in pulping. Secondary fibres: Recycling and deinking of waste papers.

IC-531N: Industrial Values & Working Ethics

Unit 1

Co-operation and working relationship with other professionals.

Confidentiality of industrial information and results.

Responsibility from acquisition of the specimen/sample to the production of data.

Accountability for quality and integrity of laboratory services.

Unit 2

Institutional ethical committee and its role.

Laboratory ethics of Safety.

Code of good and safe laboratory practice for support staff and responsibilities of the workers regarding safety.

Set up of a laboratory on the basis of safety priority and Laboratory safety Guidelines.

Unit 3

Laboratory Safety and Biosafety Level Criteria (BSL-1-4).

Wastes management, life cycle of laboratory wastes.

Reduce recycle and reuse of wastes, technology used for wastes treatment and disposal.

Chemical, electrical, fire and radiation safety. Safety organization.

Unit 4

General Safety checklist .

Hazardous properties of instruments and Laboratory chemicals.

Laboratory first-aid measures and kit.

Safety equipments, Safety signs.

IC- 532N: Polymer Chemistry

Unit-1

Basic Concepts and Polymer Characterization

General definition, Types and Classification of polymers, Concept of average molecular weights in polymers: (Number average, Weight average, Viscosity average and Sedimentation average molecular weights), Concepts of Mono-dispersity, poly-dispersity, Significance of Molecular Weight, Distribution Curves of polymers.

Unit -2

Polymerization

Kinetics and mechanism of condensation, Addition (Radical chain and Ionic chain), Coordination and Copolymerization.

Unit-3

Degradation of Polymers

Types of degradation: Random degradation and Chain depolymerisation, A general idea of thermal, mechanical and oxidative degradation, Antioxidants and stabilizers.

Unit-4

Rheology of Polymers

Viscous flow (Newtonian and Non- Newtonian fluids),Rubber elasticity (thermodynamic and entropy, elasticity), Visco-elasticity, The glassy state and glass transition temperature.

Unit-5

Polymer Processing

Plastic Technology: A general idea of Moulding and Extrusion techniques, Thermoforming and Thermofoaming.

Fiber Technology: A brief idea of textile and fabric terms and properties of fibers, Fiber Spinning techniques (melt, wet and dry spinnings).

Reference Books:

1. F.W. Billmeyer,"Textbook of Polymer Science", John Wiley &Sons, New York.
2. H.R.Allcock, F.W.Lampe and J.E Mark, "Contemporary Polymer Chemistry", PearsonEducation Prentice Hall, Singapore.
3. Charles E. Cariaher, "Polymer Chemistry:An Introduction", Marcel Dekker Inc, New York.
4. U.R.Gowariker, N.V.Vishwanathan and J. Shreedhar,"Polymer Science", New Age International Publishers, New Delhi.
5. S.S.Das and N.B.Singh,An Introduction to Polymer Science and Technology", New age International Publishers, New Delhi.

IC-533N: Inorganic Materials

Unit-1

Lattice Defects:

Introduction to types of solids, Perfect and imperfect crystals, point defects, line defect and plane defect (definition and explanation of meaning), Schottky and Frenkel defect, Nonstoichiometric defect (structural aspects), incorporation of stoichiometric excess defects, Magnetism due to defects (soft and hard magnetic materials).

Unit-2

Synthesis of Inorganic Materials:

Synthesis of solid state materials using different techniques (ceramic techniques, co-precipiattion techniques, sol-gel techniques, precursor techniques).

Unit-3

Properties of Materials

a. Optical Properties

Introduction, Optical properties of metals and non-metals, Luminescence, Photoconductivity, Lasers, non linear optical materials and optical fibers in communications.

b. Electrical Properties

Electrical conduction, Conduction in term of free electron and band theory. Semiconductors -Intrinsic and Extrinsic semiconductors and semiconductor devices.

Introduction of superconductors, High Tc super conductivity in Cuparates, preparation and characterization of 1-2-3 and 2-1-4 materials, Theory of superconductivity. Application of high Tc materials.

Unit-4

Nano Materials:

Introduction, preparation of nano materials, size property relationship, Carbon nanotubes, application of nano materials.

Unit-5

Metal clusters:

Conditions for formation of metal-metal bond. Carbonyl type clusters. Electron count in metal clustures, Isopoly and heteropoly acids and salts of Cr, V, Mo.

Books Recommended

1. A.F. Wells, Structural Inorg. Chem., ELBS & Oxford Univ. Press, 1975
2. C.N.R. Rao, A Muller & A.K. Cheetham, The Chemistry of nano-Materials, Wiley-VCH, Vol. 1 and Vol. 2, 2004.
3. F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochmann, Advanced Inorg. Chem., John-Wiley & Sons, 1999.
4. J.E. Huheey, G.A. Keiter, R.L. Keiter, Inorg. Chem.: Principles of Structures and Reactivity, Harper Collins College Publishers, 1993.
5. D.M. Bruce, Inorganic Materials, 5 Volume sets, Wiley, 2011.
6. U. Schbert, N. Husing, Synth. of Inorg. Materials, Wiley, 2005.
7. D. Bahadur, Inorg. Materials: Recent Advances, Alpha Science International Ltd., 2004.

CHE-534N: Drugs and Agrochemicals

Unit- 1

Synthetic Drugs A:

A general methods of synthesis and applications of :

i. Sulpha drugs: Sulphanilamide, sulphathiazole, sulphathalidine, sulphasuccidine, sulphaguanidine, sulphapyridine

ii. Antimalarials: **(a)** 4-Aminoquinoline derivatives: chloroquine, santoquine **(b) 8-** aminoquinoline derivatives: Pamaquine, Pentaquine.

Unit- 2

Synthetic Drugs B:

A general introduction and applications of:

i. Anti-cancer agents: Nitrogen mustards, antimetabolites in cancer chemotherapy.

ii. Psychopharmacological agents: Synthesis and applications of promazine, chloropromazine, mepazine.

iii. Antitubercular agents: Synthesis and applications of Para Aminosalicylic Acid (PAS), Thiosemicarbazones, and hydrazides.

Unit- 3

Antibiotics:

Synthesis of penicillin-G, penicillin-V, chloramphenicol,

Unit- 4

Insecticides

i. A brief reference to natural insecticides, tobacco alkaloid, pyrothrins and rotenoids (detailed chemistry not required)

ii. Organophosphorus insecticides, OMPA, Parathion, malathion,

iii. Halogenated insecticides **,** halogenated alkanes, gammexane, DDT and important analogs (DFDT, DMDT, DDD).

Unit- 5

a. Fungicides:

Synthesis and applications of following agrochemicals

Halogenated phenols and quinones, dithiocarbamates, Zineb, Maneb, Ferbam

b. Herbicides

Synthesis and applications of 2,4-D and related compounds, substituted ureas and carbamates

Reference Books:

Medicinal Chemistry by A. Burger, 2002

IC-535N: Solid State Chemistry

Unit-1

Crystal Structures:

Rock salt, Zinc blende, Wurtzite, Daimond, Graphite, Fluorite, Sesquoide, Spinel (Normal/inverse), ReO_3, Perovskite, Amorphous state, quasi-crystals, Icosahedron, Silicates, Zeolites

Unit-2

Imperfections in crystals:

Point defects: Schottky and Frenkel defects, Colour centres line defects: Edge and screw dislocations, Burger's vector, dislocation densities, dislocation multiplicity and slip dislocation and crystal growth.

Surface imperfection: Grain boundaries

Unit-3

a. Semiconductors:

Intrinsic and impurity semiconductors, Carrier concentrations, Effect of temperature aon electrical conductivity and mobility of electrons in semiconductors, Hall effect, Seebeck coefficient, p-n junctions, Organic semiconductors

b. Superconductivity

Zero resistance and transition temperature, superconductivity and periodic table, Magnetic properties, Theory of superconductivity (BCS theory), Type I and Type II superconductors, Hard superconductors, Preparation of superconducting materials and their applications.

Unit-4

Phase transformations in solids:

Classification and thermodynamics of phase transformations in solids, Experimental methods of the study of phase transformations, Phase transformations in metals, Nucleation and crystal growth mechanism, Alloys, Some compounds such as titanium dioxide, aluminium oxide, dicalcium and tricalcium silicate, Dendritic growth, Preparation of single crystals from vapour, melt and solution.

Unit-5

Solid State Reactions:

Classification, Nature of solid state reactions, Reactions involving single solid phase, solid-gas reaction, solid-solid reaction, solid-liquid reaction, Intercalation chemistry, Reactions of organic solids, factors affecting solid state reactivity, Experimental methods for the study of solid state reactions

Reference Books:

1. Solid state chemistry and applications by A.R. West (2014. 2E)
2. Phase transitions in solids by K.J. Rao and C.N.R. Rao (1978)
3. Solid state chemistry by N.B. Hannay (1967)
4. Solid state chemistry by D.K. Chakrabarty (2010)

IC-536N: Nuclear and Radiation Chemistry

Unit-1

The Atomic Nucleus:

The atom, Units used in Nuclear chemistry, The nucleus and the outer sphere, classification of nuclides, nuclear stability, atomic energy.

Unit-2

Nuclear Models:

The shell model, The liquid drop model, The Fermi gas model, The collective model, The optical model.

Unit-3

Nuclear Reactions:

Bethe's notation, types of nuclear reactions, conservation in nuclear reactions, reaction cross section, the compound nucleus theory, experimental evidence of Bohr's theory, Experiments of Ghoshal, Alexander and Simonoff, Specific nuclear reactions, Photonuclear reactions, Direct nuclear reactions, Thermonuclear reactions.

Unit-4

Nuclear fission:

The process of nuclear fission, Fission fragments and their mass distribution, Charge distribution, Ionic charge of fission fragments, Fission energy, Fission cross-sections and thresholds, Fission neutrons, Theory of nuclear fission, The nuclear Reactors.

Unit-5

Radioactivity:

Radioactive elements, General characteristics of radioactive decay, Alpha decay, Beta decay, Nuclear deexcitation, gamma emission, artificial readioactivity

The Szilard-Chalmer's reaction, Radiochemical principles in the use of tracers, Uses of nuclear radiations, Radioisotopes as a source of electricity

Reference Books

Essentials of Nuclear Chemistry by Hari Jeevan Arnikar (1995)

IC-537N: Biophysical Chemistry

Unit-1

Biological Membranes:

Mechanism of facilitated diffusion of glucose, chloride ion and bicarbonate ion through erythrocytes, Mechanism of active transport of Na^+, K^+, Ca^{+2} and proton through membrane, co-transport: symport and antiport, Brief description of Na^+ channel protein and transport antibiotics. Brief description of molecular assembly and LB films

Unit-2

a. **Nucleic acids:**

Conformation of DNA and RNA (A,B and Z forms), Genetic code and gene-protein relationship, DNA cloaning and principle of protein engineering, DNA damage and repair mechanism

b. **Proteins:**

Conformation of polypeptide chain, periodic structures in proteins: α-helix, β-pleated sheet, collagen helix and β-turn, principle of protein folding and forces involved in protein folding Structures and functions of myoglobin, haemoglobin, lysozyme and carboxypeptidase A.

Unit-3

Bioenergetics:

The mechanism of oxidative phosphorylation-chemical coupling hypothesis, the conformational coupling hypothesis and chemi-osmotic coupling hypothesis

Unit-4

Biological Regulations:

Prostaglandins, cyclic AMP and its role in hormone action, Interferon

Unit-5

Enzyme Kinetics and Theory of Enzyme Catalysis:

Presteady state kinetics, steady state kinetics, kinetics of enzyme inhibitors and determination K_1, kinetics of multisubstrate enzyme-compulsory order, random order and double displacement type mechanism, non-linear enzyme kinetics

Reference Books:

1. Biophysics by M.V. Vallenstein, MIR publication, Moscow
2. Biochemistry by L. Stryer, Freeman and Co,, San Fransisco (Indian Print CBS Publications, Delhi).
3. Biophysical Chemistry Part I, II and III by C.R. Cantor and P.R. Schimmel, Freeman and Co., San Fransisco.
4. Principles of Biochemistry by Lehninger, Neloson and COX, Worth Publishers INC, US (Indian Print CBS Publishers, Delhi)
5. Enzyme Kinteics by P.C. Engel, Chapman and Hall, London

CHE-538N: Computational Chemistry

Unit-1

Introduction to Computational Chemistry and computable quantities (structure, potential energy surface, chemical properties)

Unit-2

Construction of z-matrix

- **a.** Diatomic molecules
- **b.** Polyatomic molecules
- **c.** Ring systems

Unit-3

Force Field/Molecular Mechanics

Potential energy functional forms

i. Common force fields viz., Harmonic, LJ (6-12), LJ(10-12) and More
ii. Existing force fields in popular packages viz., AMBER, CHARMM, DREIDING and MMn

Unit-4

Ab-initio HF calculations:

- **a.** Geometry optimization and calculation of HF energy
- **b.** Basis sets
- **c.** Density functional theory

i. Basic theory
ii. Advantage over *Ab-initio* approach
iii. Gaussian, Gamess & MOLPRO
iv. Applications

Unit-5

Applications to Real systems

- **a.** Biomolecules

i. Methods for modelling Biomolecules
ii. Site-specific interaction
iii. Introduction to computer aided Drug design (CADD)

b. Synthetic route prediction

c. Polymers/ smart materials

d. Transition metals and clusters

Reference Books:

1. Introduction to computational chemistry by Frank, Jensen
2. Computational Chemistry by C.J. Cramer

Semester-IV

IC539N: Practical

Marks (Practical): 100; Time: 8 h in two days;

Marks distribution (Practical)

Practical: 75 marks

Internal Assessment: 25 marks

Exercises:

1. Analysis of ternary organic mixture
2. Estimation of glucose.
3. Separation of organic mixtures by TLC method.
4. Determination of acidity of water sample.
5. To determine density of given liquid with respect to water using pycnometer/RD bottle.
6. To determine the relative viscosity of given liquid with respect to water by Ostwald's viscometer.
7. To determine surface tension of given liquid by stalagmometer.
8. Simultaneous determination of Fe(II) and Fe(III) by UV-visible.
9. Qualitative analysis of APC Tablets by UV-Visible
10. Determination of cations, Anions, organic compounds.
11. Determination of glycerol in fruit juice
12. Determination of Na and K in cement.
13. To determine the Acidity of the fruit provided to you.

IC-540N: Research Project:

Under the research project, the student can conduct experiments, engage in review writing, perform lab work, or complete dissertation work related to the syllabus of a particular semester, all under the supervision of the assigned mentor.

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