

T. Y. B. Sc.
INDUSTRIAL CHEMISTRY
COURSE NO. : IC-301 (3 Hours, 80 Marks)
SUBJECT : ORGANIC CHEMISTRY - II

- UNIT I HETEROCYCLIC CHEMISTRY***
Nomenclature of heterocyclic systems (Five and Six membered only),
Five membered heterocycles- structure, source and electrophilic substitution reaction in pyrrole, thiophene and furan, saturated five membered heterocycles.
Six membered heterocycles- structure and source of pyridine compounds, nucleophilic and electrophilic substitution reaction in pyridine, basicity of pyridine, reduction of pyridine.
Fused ring heterocycles- Skraup synthesis of quinoline, Bischler-Nspierlaski synthesis of isoquinoline, Fischer indole synthesis.
- UNIT II POLYNUCLEAR HYDROCARBONS***
Nomenclature, structure, preparation (Haworth synthesis) and reactions of naphthalene, anthracene and phenanthrene, carcinogenic hydrocarbons, arene oxides.
- UNIT III STEREOCHEMISTRY***
Stereoisomerism, polarimeter, specific rotation, chirality, enantiomers, racemic modification, optical activity, configuration, specification of configuration: R & S, diastereomers, meso compound, conformational isomers, reactions involving stereoisomers.
- UNIT IV REACTION MECHANISM****
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| 1. Beckman Rearrangement | 2. Benzilic acid |
| 3. Hoffmann- Loffler Reaction | 4. Darzen Condensation |
| 5. Baeyer Villiger Oxidation | 6. Hunsdiecker Reaction |
| 7. Benzoin Condensation | 8. Favorskii |
| 9. Barton Reaction | 10. Chugaev Reaction |
- UNIT V SOME REAGENTS OF SYNTHETIC IMPORTANCE*****
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| 1. Aluminium isopropoxide | 2. Diazomethane |
| 3. N-Bromosuccinimide | 4. Lead tetra acetate |
| 5. Lithium aluminium hydride | 6. Osmium tetroxide |
| 7. Raney nickel | 8. Sodium borohydride |
| 9. Selenium dioxide | 10. Sodamide |
- UNIT VI STRUCTURE DETERMINATION USING SPECTRAL METHODS* & #**
NMR spectroscopy- PMR spectroscopy, shielding and deshielding , chemical shift, spin-spin splitting and coupling constant, area of signal, interpretation of PMR spectra of various simple organic molecules, Problems pertaining to the structure elucidation of organic compounds using UV, IR, Mass and PMR spectroscopy.

REFERENCE BOOKS

* Organic Chemistry by Robert T. Morrison and Robert T. Boyd (VIth Edition, Prentice Hall of India Pvt. Ltd. New Delhi)

** Organic Chemistry by R. K. Bansal (Tata McGraw – Hill Publishing Co. Ltd. New Delhi)

- *** Organic Chemistry by M. K. Jain and S. C. Jain (Shoban LAI Nagin Chand & Co. Educational Publishers, Jalandhar).
- # Spectroscopy of Organic Compounds by P. S. Kalsi (New Age International Publishers)
- **** Spectroscopy (Atomic & Molecular) by Gurdeep Chatwal, (Himalaya Publishing House).

COURSE NO. : IC-302 (3 Hours, 80 Marks)

SUBJECT : UNIT PROCESSES, SYNTHETIC DYES AND PHARMACUTICALS

UNIT-1 Nitration: Introduction, nitrating agents, mechanism, batch v/s continuous nitration process and manufacturing of Nitrobenzene (batch and continuous), m-dinitrobenzene and p-nitro acetanilide.

Amination: Introduction of amination by reduction and by ammonolysis. Different types of reduction reactions and manufacturing of Aniline by Bechamp reduction, m-nitro aniline and Aniline by ammonolysis.

Halogenations: Introduction, Mechanism and manufacturing of BHC and Chlorobenzene.

UNIT-2 Sulfonation: Introduction, sulfonating agents, mechanism and commercial manufacturing of benzene sulfonic acid (Barbet process) and Naphthalene sulfonic acid.

Oxidation: Introduction, types of oxidation reaction, oxidizing reagents and commercial manufacturing of Benzoic acid, Phthalic anhydride and Acetic acid.

Esterification: Introduction, mechanism and commercial manufacturing of Ethyl acetate and Vinyl acetate.

Hydrolysis: Introduction, hydrolyzing agents and different mechanism of Hydrolysis.

UNIT-3 Dye introduction, classification of dyes on the basis of structure and methods of application (two examples in each class). Chemistry of Azo, Anthraquinone, reactive and disperse dyes. Synthesis of Direct Black EW, Eriochrome black T, Tartrazine, Congo Red, Naphthol Blue Black-6B, Metanil Yellow, Indanthrene Yellow-4GK, Procion Brilliant 4A, Reactive Yellow3, Methyl Orange, Eriochrome Red-B dyes.

UNIT-4 Application of synthetic dyes of various fabrics and Fastness properties. Analysis of dyes and dye intermediates: nitrite value, coupling value, titanous chloride reduction, Halogen content determination and estimation of Cu, Ni and Cr.

UNIT-5 Drugs introduction: Drugs, pro-drugs, biotransformation of drugs, routes of drugs administration and dosage forms, drug binding, drug toxicity, drug addiction,

some important terms used in chemistry of drugs, biological and medical terms used in the study of drugs, distinctive definition. Classification of drugs, relation of chemical structure and chemical activity. Account of Sulfa drugs, Antipyretics and analgesics,

UNIT-6 Vitamins, Hormones, Antibiotics, Antitubercular, Antifungal and Antiinflammatory drugs.

REFERENCE BOOKS

1. Unit Processes in Organic Synthesis by P. H. Groves.
2. Synthetic Dyes by Gurdeep R. Chatwal (Himalaya Publishing House).
3. Synthetic Drugs by Gurdeep R. Chatwal (Himalaya Publishing House).
4. Organic Chemistry by M K Jain and S C Sharma., (SHOBANLAL NAGIN CHAND & CO.)
5. Handbook of Synthetic Dyes & Pigments by K. M. Shah, (Multi-tech Publishing Co.)

COURSE NO. : I. C. – 303 (3 Hours, 80 Marks)

SUBJECT : TECHNOLOGY OF PETROLEUM, PETROLEUM PRODUCTS AND POLYMERS

Unit 1 : Theories of petroleum formation, composition of petroleum, refining and rectification process of petroleum, light petroleum products, their specifications and test methods, cracking and reforming process, reaction taking place in cracking, cracking catalyst, cracking plants.

Unit 2 : Chemicals derived from C₁, C₂, C₃ and C₄ fractions, separation of components of petroleum by using techniques like- compression, absorption, adsorption, low temperature distillation, special and combined techniques. Manufacture of HCN, CS₂, Maleic anhydride, Caprolactum and Phthalic anhydride.

Unit 3 : Manufacture of Petrochemicals by following unit process :

Alkylation : ethyl benzene and isopropyl benzene from benzene

Dehydrogenation : butadiene from butane/butane

Esterification : vinyl acetate

Hydration : acetaldehyde from acetylene

Hydrolysis : ethanol from ethylene

Oxidation : ethylene oxide from ethylene and phenol from cumene

Hydroformylation : propionaldehyde from ethylene and synthesis gas

Sulphonation : benzene sulfonic acid from benzene

Unit 4 : Polymerization – classification, nomenclature of polymers, mechanism of chain polymerization, free radical polymerization and its kinetics, ionic polymerization, co-ordination polymerization.

Polycondensation- Introduction, Mechanism and effect of various parameters.

Polymer degradation.

Unit 5 : Raw material manufacture, polymerization, properties and application of PF, UF, MF, PU, epoxy resins, PE, PP, polycarbonates, PTFE.

Unit 6 : polymerization, properties and application of PVC, PS, PVA.

Fiber – natural and synthetic fiber- nylon, polyester and rayon.

Rubber – natural and synthetic, polyisoprene, butadiene, neoprene, SBR and Thiokol.

REFERENCE BOOKS :

1. A Text on Petrochemicals by Bhaskar Rao (Khanna Publishers - New Delhi)
2. Modern Petroleum Refining Process by Bhaskar Rao (Oxford & IBH Publishing Co. Pvt. Ltd. – New Delhi)
3. Advanced Petrochemicals by Dr. G. N. Sarkar (Khanna Publishers)
4. Advanced Petroleum Refining by Dr. G. N. Sarkar (Khanna Publishers)
5. Chemicals from Petroleum by A. L. Waddam (ELBS edition, London.)
6. Shreve's Chemical Process Industries by Austin (MacGrow- Hill Publication, New Delhi)
7. Riegel's Hand Book of Industrial Chemistry by James A Kent (CBS Publishers & Distributors - New Delhi)
8. Polymer Science by V. H. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, Wiley Eastern. (New Age International (P) Ltd., New Delhi)
9. Polymer Science and Technology of Plastics and Rubbers by Premamoy Ghosh (Tata McGraw-Hill Publishing Co. Ltd., New Delhi)

COURSE NO. : I. C.- 304 (3 Hours, 80 Marks)

SUBJECT : INDUSTRIAL MANAGEMENT, COSTING AND PLANT DESIGN

Unit 1 : Forms of legal ownership, ideal form of an organization, feature, advantages and disadvantages of - sole proprietorship, partnership, co-operative, joint hindu family and joint stock company.

Unit 2 : Entrepreneurship decision, Launching of a new enterprise, principal of management, Function of management – planning, directing, decision making and organising.

Unit 3 : Staffing, control, plant location, inventory management(methods for calculating economic order quantity), welfare and safety.

Unit 4 : Financial management(source of finance, working and fixed capital).

Marketing management (core concepts of marketing), pricing policy, project cost estimation, interest and depreciation.

Unit 5 : Time value of money, break even analysis, taxes, insurance, profitability criteria and selection of alternatives.

Unit 6 : Development of the project, evaluation of a process, choice of process, plant design factors, selection of process equipments and materials, reactors, plant layout.

REFERENCE BOOKS :

1. Fundamentals of Business Organisation and Management by Y. K. Bhusan (Sultan Chand & Sons – New Delhi)
2. Business Administration and Management by S. C. Saksena (Sahitya Bhawan – Agra)
3. Finance Management by I. M. Pandey (Vikas Publishing House Pvt. Ltd. – New Delhi)
4. Marketing Management by Philip Kotler. (Prentice Hall of India Pvt. Ltd. – New Delhi)
5. Plant Design Economics for Chemical Engineers by Peter and Timmerhouse. (McGraw-Hill, Inc. – New Delhi)
6. Chemical Engineering Plant Designing By Vilbrandt & Dryden (McGraw-Hill Co.)

COURSE NO. : I. C. – 305 (3 Hours, 80 Marks)

SUBJECT : INSTRUMENTATION & PROCESS CONTROL AND INDUSTRIAL SAFETY

Unit 1 : Qualities of measurement, terminology, elements of an instrument, classification of instruments, static and dynamic characteristics of an instrument, selection of instruments.

Flow measurement – classification of instruments, venturimeter, orifice meter, nozzelmeter, pitot tube, weir & notches, areameter, calculation of flow rate and discharge co-efficient.

Unit 2 : Temperature scales, expansion thermometers, Hg in glass thermometer, bimetallic thermometer, pressure thermometer, thermoelectricity, industrial thermocouples, lead wires and thermal wells, industrial resistances thermometers, thermisters, radiation pyrometers and optical pyrometers.

Unit 3 : Measurement of pressure and vacuum, classification of instruments, measuring elements for gauge pressure and vacuum, measurement of absolute, gauge and differential pressure, measurement of vacuum, pressure measurement in corrosive system.

Direct and indirect method of level measurement, sp. Gravity scales, density and sp. Gravity measurement, viscosity measurement.

Unit 4 : Indicating, recording, signalling and digital instruments, recording means and types of recorders, operating mechanism of recording devices, control panels, graphic instrumentation. Pneumatic and electrical transmission system.

Unit 5 : Control system, terminology, manual and automatic control, open and closed loop control, process time lags, control action and modes of control actions, ON-OFF and proportional control, integral and derivative control, PI, PD & PID control, control valves.

Unit 6 : Industrial hazards and safety considerations in chemical industries, mechanical, electrical and chemical hazards, fire and explosion hazards, health hazards, laboratory safety, control of plant hazards, safety practice.

REFERENCE BOOKS :

1. Industrial Instrumentation by Donald P Eckman (Wiley Estern Ltd.)
2. Mechanical & Industrial Measurement by K. K. Jain (Khanna Publishers)
3. Industrial Instrumentation & Control by S. K. Singh (Tata McGraw-Hill Pvt. Ltd., New Delhi)
4. Industrial Instrumentation & Process Control by Kulkarni (Nirali Prakashan – Pune)

5. Process Instrumentation & Control Handbook – Douglass M Considine.
(McGraw-Hill, Inc., New Delhi)

COURSE NO. : I. C. – 306 (3 Hours, 80 Marks)

SUBJECT :UNIT OPERATIONS

Unit 1 : Fluids & their classification, pressure & its measurement, mechanism of fluid flow, lines and types of flow, continuity equation, Bernaulis theory, friction & energy losses in pipes & pipelines, pipe fittings, fluid moving machineries.

Unit 2 : Modes of heat transfer, Fourier's law, thermal conductivity, thermal insulators, resistance in series and parallel, natural forced convections, LMTD, heat transfer equipments, heat exchangers, heating media, evaporation, characterisation of liquid.

Evaporators- batch and continuous type, multiple effect evaporator, capacity of evaporator, accessories of evaporator.

Unit 3 : Mixing, types of mixing problems, mixing liquids with liquids, mixing liquids with solids, mixing solids with solids, mixing viscous masses.

Filtration, filter media and fiber aid, filters- sand filters, plate & frame filters, leaf filters, rotary filter, centrifuges.

Unit 4 : Distillation- volatility and relative volatility, boiling point diagram and equilibrium diagram, types of distillation, mass and enthalpy balance calculation, calculation of number of theoretical plates, numerical and graphical method, importance of reflux ratio, steam distillation, equipments for gas-liquid contact operation, types of columns, tower packing, solvent for absorption.

Unit 5 : Crystallization- approaches for crystallization, batch and continuous crystallization, theory of crystallization.

Drying- classification of dryers, compartment dryer, tunnel dryer, rotary dryer, drum dryer, spray dryer etc., types of moisture, mechanism of drying.

Unit 6 : Leaching and liquid extraction, factors affecting leaching, industrial extractors, leaching of cellulose material and fine solids, mechanical agitators.

Size reduction and size separation, primary and secondary crushers, fine grinders, methods of operating crusher, size separation of solids, industrial screens, air separation method, size separation by laws of setting.

REFERENCE BOOKS :

1. Unit Operations : Volume I & II, by K. A. Gavhane (Nirali Prakashan- Pune)

2. Introduction to Chemical Engineering by Walter L Badger and Juline T Banchero (McGraw-Hill Book Co.)
3. Unit Operation of Chemical Engineering by Warreh L Mc Cabe & Jullian C Smith (McGraw-Hill Book Co.)
4. Chemical Engineering (volume I & II) by J. M. Coulson & K. F. Richardson (Asian Books Pvt. Ltd., New delhi)
5. Mass Transfer Operation by Treybal (McGraw-Hill Book Co.)

COURSE NO. : I. C. – 307 : PRACTICALS (6 Hours, 80 Marks)

SUBJECT : UNIT PROCESSES, SYNTHESIS OF DYES AND DRUGS

1. Preparation of intermediates and drugs based on unit process like nitration, reduction, halogenation, sulfonation, acetylation and alkylation.
2. Preparation of intermediates and dyes from different groups like nitro, nitroso and azo.
3. Analysis and estimation of dyes and drugs.
4. Dyeing of natural and synthetic fibers.

COURSE NO. : I. C. – 308 : PRACTICALS (6 Hours, 80 Marks)

SUBJECT : POLYMER CHEMISTRY & PETROLEUM TECHNOLOGY

1. Synthesis of Resins and Polymers – UF, MF, PF, Glyptal resin.
2. Determination of % purity of phenol, formaldehyde and hydrogen peroxide, determination of acid value and saponification value.
3. Analysis of petroleum products – Viscosity determination by Redwood, Saybolt and Ostwald viscometer, Distillation characteristics, Flash and Fire points, Aniline point, Diesel Index, Smoke Point, Cloud and Pour Points, Moisture Content.

COURSE NO. : I. C. – 309 : PRACTICALS (6 Hours, 80 Marks)

SUBJECT : UNIT OPERATIONS

1. Size reduction by crushers, grinders and sieve analysis of products.
2. Study of efficiency of cyclone separator.
3. Study of plate and frame filter and batch centrifuge.
4. Study of types of distillation- simple distillation and rectification, steam distillation.
5. Study of yield of crystallization with seeding and without seeding.
6. Use of hydrometers for specific gravity determination.

7. Fluid flow experiment- Raynold's experiment, friction losses, enlargement and contraction losses, venturimeter, Orificemeter.
8. Study of leaching and liquid-liquid extraction.
9. Study of dry bulb and wet bulb temperature and humidity determination.
10. Study of pipe fittings and pumps.