

B.Sc. Ist Semester-Industrial Chemistry

Course No:DSC – 6A

Course Weightage: 04 Credits

No. of Contact Hours: 60

Max. Marks:80

End Term Exam: 60

Continuous Assessments: 10

Attendance: 10

Unit-I: Industrial Gasses & Inorganic Chemicals (14 Contact hours)

(a)Industrial Gases: Large scale production, uses , storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

(b) Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum , chrome alum , potassium dichromate and potassium permanganate

Unit II: Operations in Chemical Industry: (16 Contact hours)

Distillation: Introduction, batch and continuous distillation, separation of Azeotropes-plate column, packed column.

Absorption: Introduction, Equipments-spray column, packed columns, bubble columns, packed bubble columns and mechanically agitated contractors

Evaporation: Introduction, equipments-short tubes (standard) evaporators, forced circulation evaporators, falling film evaporators, wiped (agitated) film evaporators.

Filtration: Introduction, filter media and filter aids, Equipments-plate and frame filter press, nutch filter, rotary drum filter, sparkle filter, candle filter, bag filter and centrifuge.

Unit III: Industrial Metallurgy (14 Contact hours)

Basic metallurgical operations: pulverization, calcinations, roasting, refining. Physico chemical principles of extraction of iron, copper, lead , silver, sodium, aluminum , magnesium, zinc and chromium.

Preparations of metals (ferrous and nonferrous) and ultra pure metals for semiconductor technology.

Unit IV: Environment

(16 Contact hours)

(a) Air Pollution: Pollutants and their sources, pollution by SO₂, CO₂, CO, NO_x, H₂S and other foul smelling gases. Methods of estimation of CO, NO_x, SO_x and control procedures. Green House effect and Global warming, Ozone depletion by oxides of nitrogen, Chlorofluorocarbons and Halogens. Removal of sulphur from Coal. Control of particulates.

(b) Water pollution and Water Quality Standards: Pollutants and their sources, Effluent treatment plants (primary, secondary and tertiary treatment). Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

Books Recommended :

1. *Industrial Chemistry*; E. Stocchi ; Vol – I ; Ellis Horwood Ltd. UK.
2. *Elementary Principles of Chemical Processes*; R.W. Rousseau, R.M. Felder; Wiley Publishers, New Delhi
3. *Handbook of Industrial Chemistry*; J.A. Kent, CBS Publishers, New Delhi
4. *A Textbook of Engineering Chemistry*; S.S. Dara ; S. Chand & Company Ltd. New Delhi
5. *Environmental Chemistry* ; A.K. De ; New Age International Pvt. Ltd, New Delhi
6. *Environmental Pollution Analysis*: S.M. Khopkar ; Wiley Eastern Ltd, New Delhi

B.Sc. Ist Semester-Industrial Chemistry

Course No: DSC- 6A Lab.
Course Weightage: 02 Credits
No. of Contact Hours: 30

Max. Marks: 20
End Term Exam: 15
Attendance: 05

1. Acquaintance with safety measures in a laboratory hazards of chemicals
2. Preparation of Standard solutions: Primary and Secondary solutions. Determination of H_2SO_4 and H_3PO_4 in a mixture
3. Simple Laboratory Techniques: Crystallization, Fractional crystallization, Distillation, fractional crystallization.
4. Determination of dissolved oxygen present in given water sample.
5. Determination of Chemical Oxygen Demand (COD) in given water sample.
6. Determination of Biological Oxygen Demand (BOD) in given water sample.
(only for demonstration)
7. Determination of percentage of available chlorine in bleaching powder
8. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO_3 and potassium chromate)
9. Estimation of total alkalinity of water samples (CO_3 , HCO_3^-) using double titration method
10. Determination of Temporary and permanent hardness of water using EDTA.
11. Determination of water suspended and dissolved solids
12. Estimation of dissolved CO_2 in water.

Books Recommended:

1. *Vogel's Qualitative Inorganic Analysis; S. Vohra; 7 th ed.; Orient Longman; 2004.*
2. *Advanced Practical Inorganic Chemistry; Gurdeep Raj; 24th ed.; Goel Publishing House; 2012.*
3. *Analytical Chemistry; Gary D-Christian; 6 th ed.; Wiley; 2010.*

B.Sc. IInd Semester-Industrial Chemistry

Course No:DSC – 6B

Course Weightage: 04 Credits

No. of Contact Hours: 60

Max. Marks:80

End Term Exam: 60

Continuous Assessments: 10

Attendance: 10

Unit-I: Fuels and Combustion

(14 Contact hours)

Introduction, classification of fuels, calorific value – Gross Calorific value and net Calorific value. Characteristics of good fuel.

Coal : Classification of Coal by Rank, selection of Coal, composition and carbonization of coal.

Coal gas, Producer gas and water gas composition and uses.

Fractionation of Coal tar , uses of Coal tar based chemicals. Coal liquefaction and Solvent refining.

Unit II: Petroleum and Petrochemical Industry:

(16 Contact hours)

Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking). Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels, Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives-Xylene.

Unit III: Lubricants

(14 Contact hours)

Classification, Mechanism of Lubricants (Friction and wear). Lubricating oils (Conducting and Non-conducting) and their properties. Solid and Semisolid Lubricants, Synthetic Lubricants. Properties of Greases.

Properties of Lubricants (Viscosity index, cloud point, pour point) and their determination.

Vegetables oils and Fatty acids as Lubricants. Additives for Lubricating oils.

Unit IV: Oils and Fats**(16 Contact hours)**

Classification of oils, Fat splitting, distillation of completely miscible and non-miscible oils, hydrogenation of oils, rancidity, saponification value, iodine number and acid value.

Soap and Synthetic Detergent: Classification of Surface active agents, Biodegradability of Surfactants. Preparation of Soap and detergent. Different types of soap and their composition, cleansing action of soap. Metal soaps, oils used for soaps.

Books Recommended :

1. Introduction to petroleum chemicals, H. Steiner Pergamon Press.
2. Handbook of petroleum refining processes: R.A. Meyers, McGraw Hill, New York.
3. Introduction to petroleum chemicals; H. steiner , Pergamon Press.

B.Sc. IInd Semester-Industrial Chemistry

Course No:DSC- 6B Lab.
Course Weightage: 02 Credits
No. of Contact Hours: 30

Max. Marks: 20
End Term Exam: 15
Attendance: 05

1. Determination of alkali in water samples and soaps.
2. Separation of essential oils by soxhlet extractor
3. Analysis of oils and fats (iodine value, saponification value, acid value)
4. Estimation of hardness of water by titration with soap solution
5. Estimation of Available Oxygen in Hydrogen Peroxide
6. Preparation of Soap.
7. Determination of physical constants – Refractive index, Surface tension- effect of Surfactants on Surface tension. Viscosity and optical rotation effect.
8. Determination of smoke point of Kerosene oil
9. Determination of acid value of oil or fat

Books Recommended:

1. *Vogel's Qualitative Inorganic Analysis; S. Vohra; 7 th ed.; Orient Longman; 2004.*
2. *Practical industrial chemistry, Zeba N. Siddiqui, Anmol publications Pvt. Ltd New Delhi*
3. *Advanced Practical Inorganic Chemistry; Gurdeep Raj; 24th ed.; Goel Publishing House; 2012.*
4. *Analytical Chemistry; Gary D-Christian; 6 th ed.; Wiley; 2010.*

B.Sc. IIIrd Semester-Industrial Chemistry

Course No:DSC – 6C

Course Weightage: 04 Credits

No. of Contact Hours: 60

Max. Marks: 80

End Term Exam: 60

Continuous Assessments: 10

Attendance: 10

Unit-I: Processes in Organic Chemicals Manufacture-I (16 Contact hours)

Halogenation: Kinetics of halogenation reactions, Reagents for halogenations.

Halogenation of aromatics – side chain and nuclear halogenations.

Commercial manufactures:- Chlorobenzenes, Chloral, monochloroacetic acid, dichloromethane and dichlorofluoromethane.

Sulphonation: Sulphonating agents, Factors affecting sulphonation, Kinetics and mechanism of sulphonation reactions. Commercial sulphonation of benzene, naphthalene and alkyl benzene. Batch Vs continuous sulphonation.

Oxidation: Types of oxidation reactions and oxidizing agents. Commercial manufacture of benzoic acid, Phthalic anhydride, acetaldehyde and acetic acid.

Unit II: Processes in Organic Chemicals Manufacture –II:(16 Contact hours)

Hydrogenation: Catalysts for hydrogenation reactions and hydrogenation of vegetable oil. Manufacture of methanol from CO and H₂, hydrogenation of acids and esters to alcohols.

Alkylation: Types of alkylation and alkylating agents. Thermodynamics and mechanism of alkylation reactions. Manufacture of alkyl benzenes (ethyl benzene)

Nitration: Nitration agents, kinetics and mechanism.

Nitration processes: Parafinic hydrocarbons, benzene to nitrobenzene and m-dinitrobenzene, chlorobenzene to o- and p- nitrobenzenes. Continuous Vs batch nitration.

Esterfication: Esterfication of organic acids by the addition of unsaturated compounds, esterfication of Carboxy acid derivatives. Commercial manufacture of ethyl, vinyl and cellulose acetates.

Amination;

By reduction: Methods of reduction, metal and acid, Catalytic sulphide, electrolytic, metal and alkali sulphites, metal hydrides and sodium metal.

Commercial manufacture of aniline, m-nitroaniline and p-aminophenol.

By aminolysis: Aminating agents and the factors affecting the process.

Hydrolysis: Hydrolysis agents, Mechanism and Kinetics of hydrolysis.

Unit III: Surface Chemistry, Interfacial Phenomena and Catalysis

(14 Contact hours)

Adsorption isotherm, preparation, types and applications of Sols, Gels, Emulsions, Micro-emulsions, Micelles and Aerosols. Effect of Surfactants, Hydrotropes.

Catalysis: Types, Basic principles, mechanisms and factors affecting the performance.

Introduction to phase transfer catalysis,

Enzyme Catalysed reactions and industrially important reactions.

Unit IV: Industrial Chemical Analysis **(14 Contact hours)**

Sampling procedure, sampling of bulk materials, techniques of sampling solids, liquids and gases. Collecting and processing data.

Titrimetric Analysis:- Theoretical considerations, standard solutions, primary and secondary standards, indicators and their choice in neutralization reactions. Complexometric titrations and metal-ion indicators.

Limitations of analytical methods:- accuracy, precision, errors and their types. Significant figures.

Chromatography:- Principles, working and applications of paper, TLC and Column Chromatography.

Particle size determination, rheological properties of liquids, plastics and their analysis.

Books Recommended :

1. Unit Process in organic synthesis, Groggins, P.M. ; Mc Graw Hill Book Co.
2. Chemical process principles (Part -I), Hougen, K.M. and Watson, R.A., Ragatz Asia publishing House, Bombay.
3. Elementary principles of chemical processes, Rousseau, R.W. & Felder R.M.; Wiley publishers, N. Delhi
4. Handbook of Industrial Chemistry, Kent, J.A.; CBS publishers, N. Delhi
5. Analytical Chemistry; Christian, G.D. , 6th ed. ; Wiley; 2010
6. Essentials of Physical Chemistry, Kapoor, K.L. ; Vol. 3rd & 4th ; 2nd ed.; Macmillan India Ltd.; 2005

B.Sc. IIIrd Semester-Industrial Chemistry

Course No:DSC – 6C Lab.
Course Weightage: 02 Credits
No. of Contact Hours: 30

Max. Marks:20
End Term Exam: 15
Attendance: 05

Section A:

1. To purify the organic compounds through crystallization process
2. To prepare and recrystallize the methyl orange and report the yield and calculate the % error
3. To prepare acetanilide from aniline
4. To prepare p-Bromoacetanilide
5. To prepare 2,4,6 – Tribromoaniline
6. To prepare 2,4,6 – Tribromo phenol
7. To convert hydrocarbon in Carboxylic acid through oxidation process
8. To prepare picric acid through sulphonation and nitration process
9. To convert nitro-compounds into amino compounds through reduction process
10. To convert hydroquinone into acetylated form

Section B:

11. To study the affect of additives on viscosity of a liquid (Ethanol-water; water-sucrose)
12. To compare cleansing power of two samples of detergents
13. To study the variation of viscosity of a liquid with temperature
 - a) Ethylacetate, Methyl acetate
 - b) Ethanol, Methanol, Toluene
14. Determination of molecular weight of a non-volatile solute by depression of freezing point using benzene as solvent (Napthalene , Benzamide)
15. Determination of molecular weight of a non-volatile solute by elevation of boiling point using water as solvent (urea, glucose, sucrose)

Books Recommended:

1. *Practical organic chemistry; Mann, F.G. and Saunders, B.C. ; Orient-Longman, 1960.*
2. *Textbook of practical organic chemistry, Vogel, A.I.; Tatchell, A.R. & Furnis, B.S; Hannaford, A.J. & Smith, P.W.G. ; 5th ed. Prentice Hall ; 1996*
3. *Practical physical chemistry; Khosla, B.B. ; Garg, V.C. & Gulati , A.R. ; S. Chand & Co. ; 2011*
4. *Advanced practical physical chemistry Yadav , J.B. 20th ed.; Goel publishing house; 2001*

B.Sc. IVth Semester-Industrial Chemistry

Course No:DSC – 6D

Course Weightage: 04 Credits

No. of Contact Hours: 60

Max. Marks:80

End Term Exam: 60

Continuous Assessments: 10

Attendance: 10

Unit-I: Dyes and Polymers

(16 Contact hours)

Dyes: Introduction and classification with special reference to textile, edible dyes and fabric brighteners. Industrial preparation and uses of methyl orange, malachite green and alizarin.

Polymers: General characteristics, types, functionality concept , necessity of copolymerization, block and graft copolymers. Introductory idea about conducting and biopolymers.

Methods of Polymerization: Bulk , Suspension , Emulsions and Solution

Types of Polymerization: Addition and Condensation.

Mechanism of Polymerization: Free radical, ionic (anionic, cationic), Co-ordination polymerization; initiators and inhibitors.

Synthesis, properties and applications of some thermoplastic and thermosetting polymers (Polyethene, Polystyrene, Polyamides like Nylon 6 and 66), polyurethanes, Phenol formaldehyde, Epoxy resins and neoprene.

Polymer processing:- Compression, moulding, casting , extrusion, fibre spinning, injection moulding, thermofoaming & vulcanization of elastomers.

Unit II: Drugs and Pharmaceuticals

(16 Contact hours)

Historical background and development of pharmaceutical industry in India.

Introduction to pharmacopocias , types of formulations and routes of administration.

Aseptic conditions , need and method of sterilization.

Various types of Pharmaceutical excipients: Glidants , Lubricants , diluents, preservatives , emulsifying agents , coating and colouring agents , flavouring agents and viscosity builders.

Evaluation of Crude drugs: Moisture contents, extractive value, volatile oil content, foreign organic matter, Crude fibre content. Various isolation procedures for active ingredients.

Pharmaceutical quality control: Sterility testing, progenic testing, Glass testing and Bulk density of powders.

Unit III: Corrosion and its Control

(14 Contact hours)

Introduction & economic aspects of corrosion. Dry or chemical corrosion, wet or electro-chemical corrosion ; Mechanism of electrochemical corrosion.

Galvanic Corrosion: Concentration Cell Corrosion, differential aeration corrosion, Pitting corrosion, underground or soil corrosion. Passivity.

Factors influencing corrosion: Microbiological, Galvanic and atmospheric.

Corrosion control: Proper designing , using pure metal , metal alloys , cathodic protection.

Chemical conversion:- Coating, phosphating & chromising, treatment of metal surfaces , hot dipping and use of inhibitors.

Unit IV: Quality Control and instrumental methods of analysis

(14 Contact hours)

Purification and separation, sample preparation (isolation using a suitable solvent, extraction and separation)

Solvent extraction: distillation (simple fractional and vacuum), Crystallization, Chromatographic separation (HPLC, GC, GLC and Ion exchange chromatography).

Electro-analytical techniques:- Potentiometry, Voltametry, Polarography and their industrial applications.

Spectroscopic Methods:- Principle and the industrial applications of UV-Visible spectrophotometers , IR and NMR

Atomic Spectroscopy:- principle and industrial applications of Flame photometry and Atomic absorption spectroscopy.

Books Recommended :

1. Textbook of Polymer Science, Billmeyer , John Wiley ; 2004
2. Polymer Science; Gowarikar, V.R. ; Vishwanathan, N.V and sreedhan , J. Wiley Eastern Ltd. ; 1986
3. Introduction to medicinal chemistry ; Patrick , G.L. ; oxford University Press, UK

4. Medicinal and Pharmaceutical chemistry; Hakishan; Kapoor, V.K. ; Vallabh Prakeshan, Pitampura, New Delhi
5. Industrial Chemistry; Stocchi , E; Vol. I; Ellis Horwood Ltd; UK
6. Handbook of instrumental techniques for analytical chemistry; settle, F.A; Prentice Hall
7. Analytical Chemistry; Christian, G.D. ; 6th ed. ; Wiley, 2010

B.Sc. IVth Semester-Industrial Chemistry

Course No: DSC- 6D Lab.
Course Weightage: 02 Credits
No. of Contact Hours: 30

Max. Marks: 20
End Term Exam: 15
Attendance: 05

Section A: Polymers

1. Preparation of Thiokol rubber
2. Preparation of urea – Formaldehyde mouldings
3. Preparation of Poly Phenol Formaldehyde
4. Preparation of Poly styrene by free radical mechanism

Section B: Pharmaceuticals

1. To determine the loss of moisture from any drug
2. Estimation of Aspirin by volumetric or instrumental methods
3. Analysis of Ascorbic acid in tablet sample
4. Determination of paracetamol by colorimetry
5. Determination of iron, calcium and phosphorus from a drug sample

Section C : Instrumental Methods of Analysis

1. Determination of sodium in a sample of sodium chloride by flame photometer
2. To determine the SO_4^{2-} ions present in the given amount of ferrous ammonium sulphate by ion-exchange method
3. To determine the wave length of maximum absorption (λ_{max}) and to verify the Beer Lambert's Law
4. To determine the concentration of iron by spectrophotometry using potassium thiocyanate as the complexing agent.

Books Recommended:

1. Practical chemistry; Thomas, A.O.; Scientific book centre ; Cannanore
2. Vogel's text book of practical organic chemistry; Longman
3. Production of synthetic Fibres; Vidya, A.A. ; Prentice Hall ; N. Delhi ; 1988
4. Synthetic Drugs ; Gurdeep, R.C; Himalaya publishing house, Bombay ; 1995
5. Chemical Process Industries, Shreve, R.V; Tata McGraw Hill publishing company; Mumbai