

B.Sc. Second Year Industrial Chemistry

Paper I – Material Science and Industrial Pollution.

1. **Mechanical properties** of materials and change with respect to temperature.
2. **Metals and alloys:** Important metals and Alloys, Iron, Copper, Aluminium, Lead, Nickel, Titanium and their alloys – mechanical and chemical properties and their applications.
3. **Cement:** Types of cement, composition, manufacturing process, setting of cement.
4. **Ceramics:** Introduction, types, manufacturing processes, applications, Refractory.
5. **Polymeric Materials:** Industrial polymers and composite materials – their constitutions, chemical and physical properties, Industrial applications.
6. **Glass:** Types, composition, manufacture, physical and chemical properties, applications.
7. **Corrosion:** various types of corrosion relevant to chemical industry - mechanism, preventive methods.
8. **Industrial pollution:**
Pollutants and their statutory limits, pollution evaluation methods.
Air pollution – various pollutants
Water pollution – organic/inorganic pollutants
Noise pollution
Pesticide pollution
Radiation pollution and Green House Effect.

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Paper II – Unit Processes in Organic Chemicals Manufacture.

1. **Nitration:** Introduction, nitrating agents, mechanism and nitration of paraffin hydrocarbons - benzene to nitrobenzene, m-dinitrobenzene, chlorobenzene to o & p-nitrochlorobenzenes. Acetanilide to p-nitro acetanilide, toluene, continuous Vs batch nitration.
2. **Halogenation:** Introduction, reagents for halogenations, halogenations of aromatics – side chain and nuclear halogenations, commercial manufacture of chlorobenzene, chloral, monochloroacetic acid and chloromethanes.
3. **Sulphonation:** Introduction, sulphonating agents, chemical and physical factors in sulphonation, mechanism of sulphonation, commercial sulphonation of benzene, naphthalene, alkyl benzene, batch Vs continuous sulphonation.
4. **Oxidation:** Introduction, types of oxidation reactions, oxidizing agents, mechanism of oxidation, liquid phase oxidation and vapour phase oxidation, commercial manufacture of benzoic acid, maleic anhydride, phthalic anhydride, acetaldehyde, acetic acid.

5. **Hydrogenation:** Introduction, catalysts for hydrogenation reactions, hydrogenation of vegetable oil, manufacture of methanol from carbon monoxide and hydrogen, catalytic reforming.
6. **Alkylation:** Introduction, types of alkylation, alkylating agents, mechanism of alkylation reactions, manufacture of phenyl ethyl alcohol and ethyl benzene.
7. **Esterification:** Introduction, esterification by organic acids, by addition of unsaturated compounds, esterification of carboxy acid derivatives, commercial manufacture of ethyl acetate, vinyl acetate and cellulose acetate.
8. **Amination:**
By reduction: Introduction, methods of reduction, metal and acid, catalytic sulfide, electrolytic, metal and alkali sulfites, metal hydrides, sodium metal, conc. Caustic oxidation-reduction. Commercial manufacture of aniline, m-nitroaniline, p-aminophenol.
By aminolysis: Introduction, aminating agents, factors affecting.
9. **Hydrolysis:** Introduction, hydrolyzing agents, mechanism of hydrolysis.

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Paper III - Effluent treatment & Waste management and Process Instrumentation.

1. Principles and equipments for aerobic, anaerobic treatment, adsorption, filtration, sedimentation.
 Bag filters, Electrostatic precipitator, Mist eliminator, Wet scrubbers, Absorbers.
2. Solid waste management, Industrial safety.
Principles, construction and working of following measuring instruments –
3. **pH** meter, conductivity meter.
4. **Temperature** – Glass thermometers, bimetallic thermometer, pressure spring thermometer, vapour filled thermometer, resistance thermometers, and radiation pyrometers.
5. **Pressure** – Manometers, barometers, bourdon pressure gauge, bellow type, diaphragm type pressure gauge, Macleod gauges, pirani gauges etc.
6. **Liquid Level** – Direct-Indirect liquid level, measurement, float type liquid level gauge, ultrasonic level gauges, bubbler system.
7. **Viscosity and Density** measurement.

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Practical:

1. Determination of flash point, ignition point of liquids.
2. Determination of smoke point of a fuel.
3. Water analysis – Solid content, hardness, COD and other tests as per industrial specifications.
4. Separation of organic and inorganic mixture by TLC.
5. Instrumental methods of analysis – pH meter and conductivity meter.
6. **Unit process** – one or two examples of each of the following unit processes.
Nitration, sulphonation, friedel crafts reaction, esterification, hydrolysis, oxidation, halogenations, chlorosulphonation, reduction and polymerization.
7. Limit tests for heavy metals – Pb, As, Hg, Fe and ash content.

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COMPULSORY PAPERS

Paper I – Industrial Chemical Analysis.

1. **Sampling** procedures, sampling of bulk materials, techniques of sampling – solids, liquids and gases. Collection and processing of data.
2. **Chromatography:** Principles, working and applications of – paper chromatography, TLC, GLC, HPLC.
3. Particle size determination, rheological properties of liquids, plastics and their analysis.
4. **Modern Instrumental Methods of analysis –**
UV-visible spectroscopy
IR spectroscopy and non-dispersive IR
Raman spectroscopy,
NMR Spectroscopy,
Electron spin resonance spectroscopy
Atomic absorption spectroscopy
Flame photometry
Neutron diffraction
X-ray fluorescence
Ion chromatography

Paper IV – Chemical Process Economics and Entrepreneurship.

1. Factors involved in project cost estimation, methods employed for the estimation of capital investment. Capital formation, elements of cost accounting. Interest and investment costs, time value of money equivalence.
2. Depreciation, methods of determining depreciation. Some aspects of marketing, pricing policy, profitability criteria, economics of selecting alternatives, variation of cost with capacity, break-even point, optimum batch sizes, production scheduling etc.
3. Need, scope and characteristics of entrepreneurship, special schemes for technical entrepreneurs development (STED), exposure to demand based, resource based, service based. Import substitute and export promotion industries, criteria for principles of products selection and developments.
4. Choice of technology: plant and equipments. Techno-economic feasibility of the projects. Plant layout and process planning for the project.
5. Financial Institutions, their procedure and incentives, financial ratio and their significance. Books of accounts, financial statements and Funds flow analysis. Energy requirement and utilization.
6. Resources management: men, machine and materials. Creativity and Innovations. Problem solving approach. Strength, weakness, opportunity and threat (SWOT) techniques.
7. Quality control, quality assurance and testing of the product. Packaging and advertising. After sales service.
8. Sickness in small scale Industries and their remedial measures. Licensing and registration. Important provisions of Factory Act, sales of goods Act, partnership Act.

Practical:**

1. Synthesis of common industrial compounds involving two step reactions, e.g. 4-bromo aniline, 3-nitroaniline, sulphanilamide, 4-amino benzoic acid, 4-nitro benzoic acid, dihalobenzenes, nitrohalobenzenes, paracetamol, oils of winter green.
2. Determination of acid value, Iodine value and saponification value.
3. Instrumental methods of analysis – colorimeter, flame photometer.
4. Preparation of urea formaldehyde resin.
5. **Industrial analysis** – analysis of common raw materials as per the industrial specifications such as phenol, aniline, formaldehyde, hydrogen peroxide, acetone, etc.
6. Limit tests for chlorine, heavy metals, arsenic of drugs.
7. Determination of sulphate ash, loss on drying of drugs.
8. Identification of drugs by TLC.