B.Sc. Third Year Industrial Chemistry

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.

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OPTIONAL PAPERS*

Paper 1: Polymers.

1. Brief history of macromolecular science, general characteristics of polymers in comparison with common organic compounds. Types of polymers - functionality concept, necessity of copolymers and copolymerization, block and graft copolymers. Conducting Polymers. Biopolymers.
2. **Methods of polymerization** – bulk, suspension, emulsion and solution.
3. **Types of polymerizations** – addition, condensation, mechanism of polymerization – free radical, ionic (anionic and cationic), co-ordination polymerization, initiators, inhibitors.
4. **Synthesis, chemistry, properties and applications of the following Thermosetting polymers:-**
   Phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, Polyurethanes, Polycarbonates, Epoxy resins – grades and curing process, Silicones.
   Elastomers – polyisoprene, polybutadiene and neoprene.
5. **Synthesis, chemistry, properties and applications of the following Thermoplastics polymers:-**
   Polyethylene – HDP, LDP, LLDP. Polyvinyl chloride, Teflon.
   Polystyrene – SBR, ABS, SAN.
   Vinyl polymers – PVA, PVB.
   Polyacetals, Polyamides – nylon-6, nylon-66
   Polyethers and Polyesters – terephthalates. Cellulosic polymers.
6. **Molecular weight distribution** – number, weight and viscosity average molecular weights of polymers, methods of determining molecular weights.
7. **Degradation** of polymers by thermal, oxidative, mechanical and chemical methods.
8. **Polymer processing** – compression molding, casting, extrusion, fibre spinning, injection molding, thermoforming, vulcanization of elastomers, polymer industry in India.

Paper 2: Heavy and Fine chemicals.

1. **Heavy Inorganic Chemicals –**
   Manufacture of following with reference to –
   (i) Raw material,
   (ii) production process,
   (iii) quality control,

(iv) hazards and safety,
(v) Effluent management.

Ammonium phosphates, super phosphate, triple super phosphate, carbon blacks, manufacture of graphite and carbon, calcium carbide, silicon carbide, sodium thiosulphate, borax and boric acid.

Industrial catalysts – raney nickel, other forms of nickel, palladium and supported palladium, copper chromate, vanadium and platinum based catalyst. Aluminium alkoxides, titanium tetrachloride and titanium dioxide.

2. **Fine Chemicals –**
Manufacture of following with reference to –
(i) Raw material,
(ii) production process,
(iii) quality control,
(iv) hazards and safety,
(v) Effluent management.
Sodium borohydrate, lithium aluminium hydride, sodium ethoxide, paracetamol, indigo, vat dyes. Essential oils, surfactants and emulsifying agents, coloring agents- manufacture of some natural and synthetic colors. Flavouring agents – fragrance and food additives. Biochemical reagents – ninhydrin, tetrazolium blue, 1,2-naphthaquinone-4-sulphonate.

3. **Heavy Organic Chemicals –**
Manufacture of following with reference to –
(i) Raw material,
(ii) Flow chart,
(iii) Effluent management.
(iv) Uses.

Fischer-tropsch synthesis. Applications and uses of zeolites as catalyst. Propargyl alcohol, 1,4-butanediol, vinyl chloride, pyridines, picolines, phthalic anhydrides, glycerol, sorbitol, chloroform, ethanolamine. Industrial solvents – DMF, DMSO, sulpholane, alkyl pyrrolidone, THF, dioxane.

Paper 3: Pharmaceuticals.

1. Historical background and development of pharmaceutical industry in India. Introduction to pharmacopoeias. Types of formulations and roots of administration. Aseptic conditions, need for sterilization, Method of sterilization.

2. **Various types of pharmaceutical excipients** – their chemistry, process of manufacture and quality specifications – Glidants, lubricants, diluents, preservatives, antioxidants, emulsifying agents, coating agents, binders, coloring agents, flavouring agents, gelatin and other additives, sorbitol, mannitol, viscosity builders etc.

3. **Evaluation of crude drugs** – moisture contents, extractive value, volatile oil content, foreign organic matter. Quantitative microscopic exercises including of starch, crude fiber content. Various isolation procedures for active ingredients.

4. **Chemical constitution of plants** – including carbohydrates, amino acids, proteins, fats, waxes, volatile oils, terpenoids, steroids, saponins, flavonoids, tannins, glycosides, alkaloids.

5. **Pharmaceutical Quality Control** – sterility testing, pyrogenic testing, glass testing, bulk density of powders etc.

6. **Raw materials, process of manufacture of the following bulk drugs –**

   Sulpha drugs – sulphaguanidine, sulphamethoxazole

   Antimicrobial – chlorampinecol, Na-PAS.

   Analgesic-anti-inflammatory – salicylic acid and its derivatives, ibuprofen, mefenamic acid.

   Steroidal hormones – Progesterone, Testosterone, Methyl Testosterone.

   Vitamins – vitamin-A, vitamin-B6, vitamin-C.

   Blockers – propranolol, atenolol.

   Cardiovascular agent – methyl dopa.

   Antihistamines – chloropheneramine maleate.

   Antibiotics drugs – penicillin-G, semi synthetic penicillin, rifamycin, tetracycline, and vitamin-B12.

   Antimalarial drugs. Anticancerous drugs. AntiAIDS vaccines.

7. **Brief idea of microorganisms** - their structure, growth and usefulness. Biotransformation processes – for prednisolone, 11-hydroxylation in steroids. **Enzyme systems** - useful for transformation, microbial products, enzyme catalyzed transformation - manufacture of ephedrine.