

B.S. 1.11.11
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~~KISHINGHAND CHELLARAM COLLEGE~~

~~U.G.C. PROGRAMME ON VOCATIONAL EDUCATION~~
~~AT UNDERGRADUATE LEVEL~~

INDUSTRIAL CHEMISTRY FIRST YEAR B.Sc.

917

6

PAPER I:	<u>Marks</u>
SECTION I: GENERAL CHEMISTRY	(25)
IC 1. Nomenclature Generic names. Trade names.	20
IC 2. Raw material for organic compounds petroleum, Natural gas, Fractionation of crude oil, cracking reforming, hydroforming, isomerisation.	12
IC 3. Coal, Types. Structure. Properties, distillation of coal, chemicals derived therefrom.	8
IC 4. Renewable natural resource: Cellulose starch properties modification, important industrial chemical derived from them. Alcohol and alcohol based chemicals, oxalic acid, furfural.	7
IC 5. Inorganic materials of industrial importance: their availability, forms, structure and modification. Alumina, silica, silicates, clays, mica, carbon, zeolites.	13
SECTION II: GENERAL CHEMISTRY	
IC 6. Basic metallurgical operations, Pulverisation, Calcination, Roasting, Refining.	5
IC 7. Physicochemical principles of extraction of: Iron, Copper, Lead, Silver, Sodium, Aluminium, Magnesium, Zinc, Chromium.	12

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Marks 25

7

Paper II

SECTION II - UNIT OPERATIONS AND ENERGY BALANCE IN CHEMICAL INDUSTRY.

- IC 13. Energy Balance: Heat capacity of pure gases and gaseous mixtures at constant pressures soluble heat changes in liquids, enthalpy changes. 25
- IC 14. Distillation : Introduction : Batch and continuous distillation separation of azeotropes, Plate columns and Packed column. 25
Absorption : Introduction : Equipments - packed columns, spray columns, bubble columns, packed bubble columns, mechanically agitated contactors 25
- IC 15. Evaporation : Introduction : Equipments - short tube (standard) evaporator, forced circulations evaporators, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporated. 25
Filtration : Introduction ; Filter media and filter aids, equipments-plate and frame filter press, nutch filter rotary drum filter, sparkler filter, candle filter, bag filter, centrifuge. 25
Drying : Introduction: Free moisture, bound moisture, drying curve, Equipments - tray dryer, rotary dryer, flash dryer, fluid bed dryer, spray dryer. 25
- IC 16. Crystallisation : Introduction; Solubility, super-saturation, nucleation crystal growth, equipment tank crystallizer, agitated crystallizer, evaporator crystallizer, draft tube crystallizer. 25
- IC 17. Fluid flow : Fans, blowers, compressors, vacuum pumps, ejector. Pumps : Reciprocating pumps, Gear pumps, Centrifugal pumps. 25
Heats Transfer : Heat exchanges - shell and tube type finned tube heat exchangers, plate heat exchangers, refrigeration cycles.
- IC 18. Extraction : Introduction : Selection of solvents; Equipments - Spray column, packed column, rotating disk column, mixer - settler. 25
Mixing : Introduction, mixing of liquid-liquid, solid-solid, liquid-solid systems.

Paper III

M.M. 15

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IC-8. Surface chemistry and Interfacial phenomena: Adsorption isotherm, Sols, Gels, Emulsions, Microemulsions, Micelles, Aerosols, Effect of surfactants, Hydrotropes. 16L

IC-9. Catalysis: Introduction, Types, Homogeneous and heterogeneous, Basic principles, Mechanisms factors affecting the performance. Introduction to phase transfer catalysis, Enzyme catalysed reaction -Rate model. Industrially important reaction. 14L

PAPER II

SECTION I: MATERIAL BALANCE, UTILITIES IN CHEMICAL INDUSTRY.

IC-10. Dimensions and Units: Basic Chemical Calculations -Atomic weight, molecular weight, equivalent weight mole, compositions of (i) liquid mixture and (ii) gaseous mixtures. 2L

IC-11. Material Balance without Chemical Reaction: Flow diagram for material balance, simple material balance with or without recycle or by pass for chemical engineering operations such as distillation, absorption, crystallisation, evaporation, extraction etc. 7L

IC-12. Material Balance involving chemical reaction: Concept of limiting reactant conversion, yield Liquid phase reaction, gas phase reaction, with/without recycle or by-pass 9L

Utilities in Chemical Industry

Fuel - Types of fuels - Advantages and disadvantages, combinations of fuels, calorific value, specification for fuel oil.

Boilers - Types of Boilers and their functions.

Water - Specifications for industrial use, various water treatments.

Steam - Generation and use.

Air - Specification for industrial use. Processing of air.

The above syllabus is ~~formed~~ ^{approved} for 3 papers of Industrial Chemistry.

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21/2/95

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21/2/95

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21/2/95

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21/2/95

Industrial Chemistry
Bsc II - Paper I

Max Marks - 25

4

920

IC 2 Nitration : Introduction - nitrating agents, Kinetics and mechanism of nitration, Processes such as nitration of : 10.L

i) Paraffin hydrocarbons

ii) Benzene to nitrobenzene and m.dinitrobenzene.

iii) Chlorobenzene to ortho and p.nitrochlorobenzene;

iv) Acetanilide to p.nitroacetanilide.

v) Toluene.

Continuous vs Batch nitration :

IC 3 Halogenation: Introduction - Kinetics of halogenation reactions. Reagents for halogenation, Halogenation of aromatic-side chain and nuclear halogenations, Commercial manufacture- chlorobenzenes, chloral, monochloroacetic and chloromethanes, dichlorofluoromethane. 6.L

IC 4 Sulphonation: Introduction- Sulphonating agents, chemical and physical factors in sulphonation, Kinetics and mechanism of sulphonation reaction, Commercial sulfonation of benzene, naphthalene, alkyl benzene. Batch vs continuous sulphonation. 6.L

IC 5 Oxidation: Introduction- Types of oxidation reactions, oxidising agents, kinetics and mechanism of oxidation of organic compounds, Liquid phase oxidation, vapour phase oxidation, Commercial manufacture of benzoic acid maleic anhydride, phthalic anhydride, acrolein, acetaldehyde, acetic acid. 5.L

IC 6 Hydrogenation: introduction-Kinetics and thermodynamics of hydrogenation reactions, Catalysts for hydrogenation reactions. Hydrogenation of vegetable oil, manufacture of methanol from carbon monoxide and hydrogen, hydrogenation of acids and esters to alcohols, catalytic reforming. 4.L

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Paper II

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IC 7 Alkylation: Introduction: Types of alkylation, Alkylating agents, Thermodynamics and mechanism of alkylation reactions, manufacture of alkyl benzenes (for detergent manufacture), Ethyl benzene, phenyl ethyl alcohol, N alkyl anilines (mono and di-methyl and ethyl aniline).
Esterification: Introduction: Hydrodynamics and kinetics of esterification reactions, esterification by organic acids, by addition of unsaturated compounds, esterification of carboxy acid derivatives, commercial manufacture of ethyl acetate, diacetyl phthalate, vinyl acetate, cellulose acetate.

IC 8 Amination: (A) By reduction:

Introduction, Methods of reduction metal and acid, catalytic, sulphide, electrolytic, metal and alkali sulfites, metal hydrides, sodium metal, concentrated caustic oxidation, reduction, commercial manufacture of aniline, m-nitroaniline, p-amino phenol.

(B) By aminolysis: Introduction, aminating agents, factors affecting aminolysis.

Hydrolysis: Introduction: hydrolysing agents, Kinetics, thermodynamics and mechanism of hydrolysis.

Paper II
POLLUTION

IC 9 Air, oxygen, nitrogen cycle, water, biosphere, flora and fauna, energy soil.

IC 10 Pollutants and their statutory limits. Pollution evaluation methods.

IC 11 Air pollution- Various pollutants, Water pollution- Organic/Inorganic pollutants, Noise pollution
Sewage analysis
Pesticides pollution
Radiation pollution, Green house effect, future.

IC 12 Principles and equipments for aerobic, anaerobic treatment, adsorption, filtration, sedimentation.

Bag filters, electrostatic precipitator, mist eliminators, wet scrubbers.

Absorbers

Solid waste management.

Industrial safety.

Bse II - III

Second Year B.Sc. (100)

Paper III

Max Marks (25)

922

MATERIAL SCIENCE

- IC 1 Mechanical properties of materials and change with respect to temperature. 2.L
- Material of construction used in Industry.
- Metals & Alloys - 9.L
- Important metals and alloys:
Iron, copper, aluminium, lead, nickel, titanium & platinum & their alloys - Mechanical and chemical properties and their applications.
- Cement - 6.L
- Types of cement, composition, Manufacturing process, setting of cement
- Ceramics - 6.L
- Introduction, types, manufacturing processes Applications, Refractories.
- Polymeric materials- 8.L
- Industrial polymer and composite materials. Their constitution, Chemical & Physical properties, Industrial applications.
- Glass- 6.L
- Types, composition, Manufacture, Physical and Chemical properties, Applications.
- CORROSION- 6.L
- Various types of corrosion relevant to Chemical Industry, Mechanism, Preventive methods.
- IC 13 Concept of measurement and accuracy. 5.L
- Principle, construction and working of following measuring instruments:
- Temperature, glass, thermometers, bimetallic thermometer, pressure spring thermometer, vapour filled thermometers resistance thermometers, radiation pyrometers. 12.L
- IC 14 Pressure: Manometers, barometers, bourdon pressure gauge, bellow type, diaphragm type pressure gauges, mechanical gauges, pirani gauges etc. 9.L
- Liquid level: Direct - Indirect liquid level measurement, flat type liquid level gauge, ultrasonic level gauges, bubbler system. 10.L
- Density measurement. 4.L
- Viscosity measurement, Transducers, flash point, ignition point. 4.L

McLeod gauge

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~~KISHINCHAND SHELLARAM COLLEGE, BOMBAY 400 020.~~

~~VOCATIONAL COURSE IN INDUSTRIAL CHEMISTRY~~

~~B.Y.B.Sc.
SYLLABUS~~

B.Sc III Industrial Chemistry
Paper I

7
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MM-35

SECTION I

CHEMICAL PROCESS ECONOMICS:

- IC. I Factors involved in project cost estimation. Method employed for the estimation of capital investment.
- Capital formation, Elements of cost accounting.
- Interest and investment cost. Time value of money equivalence.
- Depreciation, methods of determining, depreciation, Taxes.
- 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.
- IC. II Concept of scientific management in Industry.
- Functions of management, decision making.
- Planning, organising, directing and control,
- Location of Industry.
- Materials management.
- Inventory control.
- Management of human resources-selection incentives welfare and safety.

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B.Sc III Industrial Chemistry

~~HEAVY AND FINE CHEMICALS~~

Paper II

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Max marks: 35

PART I

Heavy Inorganic Chemicals

Manufacture of the following with reference to

- (i) Consumption pattern
- (ii) Raw materials
- (iii) Production process
- (iv) Major engineering aspects
- (v) Special material of construction
- (vi) Quality control
- (vii) Hazards and safety
- (viii) Effluent management.

Synthetic nitrogen products - ammonia, nitric acid, ammonium nitrate and ammonium sulphate.

Chlor-alkali industrial products - Caustic soda, chlorine.

Phosphorus chemicals - Phosphorus, phosphoric acid, ammonium phosphate, super phosphate, tripple superphosphate.

Industrial carbon - carbon blacks, manufacturer of graphite and carbon.

Lime, gypsum.

Silicon, calcium carbide, silicon carbide.

Fluorine, bromine, iodine, hydrobromic acid, inter halogen compounds.

Sodium chloride, sodium sulphate, sodium sulphite, sodium thio-sulphate, borax, boric acid.

Industrial catalysts - Raney nickel, other forms of nickel, palladium and supported palladium, copper chromate, vanadium, and platiun based catalyst.

Aluminium, alkoxides, titanium tetrachloride, and titanates, titanium dioxide.

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Page II
BSc III Industrial Chemistry
Paper II

P/2
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PART II

Heavy Organic chemicals

Manufacture of the following with reference to -

- (i) Raw materials
- (ii) Flow chart
- (iii) Effluent managements
- (iv) Kinetics
- (v) Uses

Fischer-Tropsch synthesis - examples

Applications and uses of zeolites as catalyst. Their use in isomerization and dehydration/dehydroxylation.

(10)

Chemicals derived from acetylene - Acetylene, propargyl alcohol, 1,4-butene diol, acrylates, vinyl esters, vinyl chloride. Pyridine, picolines, phenols, acetone, resorcinol, phthalic anhydride.

(11)

Glycerol, sorbitol, melamine, formaldehyde, formic acid. Triphenyl phosphine, alkyl phosphates, chlorination of methane to methyl chloride, dichloroethane, chloroform, carbon tetrachloride.

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Ethanolamine, mono-, di-, tri-ethanolamines, dialkyl aminoethanols (dimethyl, diethyl).

Alkylamine - methylamine, ethylamine, di-, tri-alkylamines (methyl, ethyl), butyl amines, propyl amines.

Ketenes, ethyl and methyl acetoacetates.

Acetylaldehyde, paraldehyde

Speciality industrial solvents- DMF, DMSO, Sulpholane, alkylpyrrolidone, THF, dibutyl ether, diethyl ether, diglyme, dimethoxyethane, dioxane.

B.Sc III Industrial Chemistry

Paper III

Page Marks - 35

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PART III

Fine and Speciality chemicals

Reagents - Laboratory chemicals from heavy chemical industry in required purity - acids, alkalis, carbonates drying agents.
Analytical reagents - sodium carbonates, sodium bicarbonates, potassium dichromate, oxalic acid, perchloric acid.
Common solutions - Fehling solution, Karl-Fischer reagent.

Chromatographic Materials and HPLC solvents - Coating material, pre-coating of plates, spectroscopy grade chemicals - methanol, ethanol, potassium bromide, carbon tetrachloride, nujol, chloroform.

Biochemical Reagents - Ninhydrine, tetrazolium blue, 1,2-naphthaquinone-4-Sulphonate.

Manufacture of following fine chemicals with reference to

(i) Raw materials of common industrial compounds involving two step reactions. - for example 4-bromo aniline, 3-nitroaniline, sulpterial.

(ii) Production process

(iii) Special material of construction

(iv) Hazard and safety.

(v) Effluent management.

(vi) Quality control

(vii) Specifications.

Sodium borohydrate, lithium aluminium hydride, sodium amide, sodium ethoxide, sodium methoxide

Paracetamol, Indigo, Vat dyes, Reactive dyes.

Essential oils - general, organic flavour, camphor, citral, citronellol, menthol.

Surfactants and emulsifying agents - PEG, Tweens, spans.

Colouring agents- manufacture of some natural and synthetic colours.

Flavouring agents - fragrances and food additives.

Natural tartaric acid, (+) tartaric acid, resolution of tartaric acid, Citric acid.

Chemicals required for electronic industry.