KISHINCHAND CHELLARAM COLLEGE

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

INDUSTRIAL CHEMISTRY
FIRST YEAR B.Sc.

PAPER I:

SECTION I: GENERAL CHEMISTRY


IC 2. Raw material for organic compounds. Petroleum, Natural gas, Fractionation of crude oil, cracking, reforming, hydroforming, isomerisation.


SECTION II: GENERAL CHEMISTRY


IC 7. Physicochemical principles of extraction of: Iron, Copper, Lead, Silver, Sodium, Aluminium, Magnesium, Zinc, Chromium.
SECTION II: UNIT OPERATIONS AND ENERGY BALANCE IN CHEMICAL INDUSTRY.

soluble heat changes in liquids. Enthalpy changes.

IC-14. Distillation: Introduction; Batch and continuous distillation separation of azeotropes.
Plate columns and Packed column.

Absorption: Introduction; Equipments - packed columns, spray columns, bubble columns,
packed bubble columns, mechanically agitated contractors.

IC-15. Evaporation: Introduction; Equipments - short tube (standard) evaporator, forced
circulations evaporators, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporated.

Filtration: Introduction; Filter media and filter aids, equipments-plate and frame
filter press, watch filter, rotary drum filter, sparkler filter, candle filter,
bag filter, centrifuge.

Drying: Introduction; Free moisture, bound moisture, drying curve, Equipments - tray
dryer, rotary dryer, flash dryer, fluid bed dryer, spray dryer.

IC-16. Crystallisation: Introduction; Solubility, super-saturation, nucleation crystal growth,
equipment tank crystallizer, agitated crystallizer, evaporator crystallizer,
draft tube crystallizer.

Pumps: Reciprocating pumps, Gear pumps, Centrifugal pumps.

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.

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.

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.

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

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.

The above syllabus is approved for 3 papers of Industrial Chemistry.

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2. [Signature] 21/1/95
3. [Signature] 21/3/95

N. S. Chandra
21/12/95

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N. S. Chandra
21/12/95
IC 2 Nitration: Introduction - nitrating agents, kinetics and mechanism of nitration, processes such as nitration of:

i) Paraffin hydrocarbons

ii) benzene to nitrobenzene and m-nitrobenzene.

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 and aliphatic halogenations;

Commercial manufacture- chlorobenzene, chloral, monochloroacetic and chloromethane, dichlorofluoromethane.

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

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, metolic anhydride, phthalic acid, acrolein, acetaldehyde, acetic acid.

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.

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 sulphites, metal hydrides, sodium, concentrated caustic oxidation, reduction, commercial manufacture of aniline, p-nitroaniline, p-amine phenol.

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


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 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.
MATERIAL SCIENCE

10.1 Mechanical properties of materials and change with respect to temperature.

Material of construction used in Industry.

Metals & Alloys -

- Important metals and alloys:
  - Iron, copper, aluminium, lead, nickel,
  - Titanium & platinum & their alloys -
  - Mechanical and chemical properties and their applications.

Cement -

- Types of cement, composition,
- Manufacturing process, setting of cement

Ceramics -

- Introduction, types, manufacturing processes
- Applications, Refractories.

Polymeric materials -

- Industrial polymer and composite materials,
- Their constitution, chemical & physical properties, Industrial applications.

Glass -

- Types, composition, Manufacture, Physical and Chemical properties, Applications.

Corrosion -

- Various types of corrosion relevant to Chemical Industry, Mechanism, Preventive methods.

IC 13 Concept of measurement and accuracy.

Principle, construction and working of following measuring instruments:

- Temperature, glass, thermometers, bimetallic thermometer, pressure spring thermometer,
- Vapour filled thermometers, resistance thermometers, radiation pyrometers.

IC 14 Pressure: Manometers, barometers, bourdon pressure gauges, bellows type,

- Diaphragm type pressure gauges, mechanical gauges, pirani gauges etc.

Liquid level: Direct - Indirect liquid level measurement, flat type liquid level gauges,
- Ultrasonic level gauge, bubbler system.

Density measurement.

Viscosity measurement, Transducers, flash point, ignition point.
SECTION I

CHEMICAL PROCESS ECONOMICS:

IC. 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.
Ion Chromatography

Ion-selective electrodes

X-ray fluorescence

Nuclear activation. Gamma and X-ray spectroscopy

IR-spectroscopy and non-stationary IR

UV-visible spectroscopy

Modern Instrumental Methods of Analytical Chemistry

and their analysis

Physical properties of liquids, glasses, plastic,

particulate size determination

TLC, GLC, HPLC

Chromatographic paper, paper chromatography.

Techniques of sampling and processing of data

Sampling procedures, sampling of bulk

Iodometric

Industrial Chemistry, Analytical

SECTION II

Pl

II Part 1. Industrial Chemistry
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, triple 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 thiosulphate, borax, 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 titanates, titanium dioxide.
Applications and uses of zeolites as catalysts. Their use in Fischer-Tropsch syntheses — examples

(8) Uses
(14) Kinetics

(111) Efficient management

(11) Flow chart
(1) Raw materials

— Manufacture of the following with reference to —

Heavy Organic Chemicals

Part II
Perkin II

Acetone, diethyl ether, ether, dibutyl ether, diethyl ether, dichloromethane, pyridine, THF, dichloroethane, tetrahydrofuran, dimethylformamide.

Speciality Industrail Solvences - DME, DMSO, Suprinoamine, Akyl acetate, perdeuterated, paraformaldehyde.

Ketenes, ethyl and methyl acetocetates.

Acetophenone - methylacetone, ethylacetone, di-, tri-, and polyacetylenes.

Diphenylmethane, mono-, di-, tri- ethynolamines, datkyl anilines.

Acetyldedone, cyclohexyl acetonitrile, chloroform, carbon tetrachloride.

Phosphoryl chloride, alkyl phosphates, chlorination of methane to triphenylphosphine, formyl chloride, formic acid.

Acetylene, propyne, propyne, propyne, acetone, rectorite, smectite.

Anhydride, polycrines, phenois, acetone, rectorite, phosphite.

1,4-butanediol, styrenes, vinyl esters, vinyl chloride.

Chemicals derived from acetylene - acetylene, acetylene, propargyl alcohol.
PART III

Fine and Speciality chemicals

Reagents - Laboratory chemicals from heavy chemical industry in required purity - acids, alkalies, 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, sulpertial.

(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, benzol.

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.