

JIWAJI UNIVERSITY, GWALIOR

SYLLABUS

B. Sc. INDUSTRIAL CHEMISTRY

2011-2014

<b>Semester I</b>			
Paper	Course	Marks	Distribution
Paper I	Industrial Aspects of Physical, Organic and Inorganic Chemistry	100	70+30
Practical		50	
<b>Semester II</b>			
Paper	Course	Marks	Distribution
Paper I	Unit Operation and Material Balance	100	70+30
Practical		50	
<b>Semester III</b>			
Paper	Course*	Marks	Distribution
Paper I	Material Science, Measurement, Accuracy And Environmental Chemistry	100	70+30
Practical		50	
<b>Semester IV</b>			
Paper	Course	Marks	Distribution
Paper I	Unit Process in Organic Synthesis and Polymer Science-I	100	70+30
Practical		50	
<b>Semester V</b>			
Paper	Course	Marks	Distribution
Paper I	Chemical Process Economics, Industrial Organization And Polymer Science-II	100	70+30
Practical		50	
<b>Semester VI</b>			
Paper	Course	Marks	Distribution
Paper I	Industrial Chemical Analysis and Polymer Science- III	100	70+30
Practical		50	

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JIWAJI UNIVERSITY, GWALIOR

INDUSTRIAL CHEMISTRY

B.Sc. I SEMESTER

Industrial Aspects of Physical, Organic and Inorganic Chemistry

**UNIT-1**

**Dimensions and units-** Basic chemical calculations , atomic weight , molecular weight , equivalent weight , mole , composition of liquid mixtures and gaseous mixtures.

**Adsorptions-** Introduction . adsorption of gases on solids , adsorption from solution , applications of adsorption , adsorption isotherm.

**Catalysts and catalysis-** introduction of catalysts criteria or characterization of catalyst , types of catalysts , types of homogenous and heterogenous catalysis , basic principle and mechanism of catalysis.

Factors affecting the performance of catalysis , introduction of phase transfer catalysis , enzyme catalyzed reactions , rate model , industrially important reactions.

**UNIT-2**

**Petroleum refining and petrochemicals-** Introduction. composition of petroleum . classification of refinery products , dye intermediates , natural gas.

**Petroleum refining and petrochemicals-** Thermal cracking, hydro cracking, fluid catalytic cracking, reforming, hydroforming , isomerisation , product of benzene and toluene.

**Coal-** Introduction, types, composition, properties, distillation of coal, caking and non caking coal, pulverized coal, role of sulfur and ash in coal.

**UNIT-3**

**Fuels-**Types of fuels, advantages, disadvantages of combustion of fuels, calorific value , specifications for fuel oils.

**Renewal of Natural Resources-**Introduction, manufacture and industrial applications of cellulose and

**Fermentation-** Introduction, microorganism and their growth requirements general outline of the process, manufacture of beer, wine and vinegar.

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#### UNIT-4

**Basic metallurgical operations-** Pulverization , Calcination , roasting , refining.

Physico chemical principles of extraction of iron , copper , lead.

Physico chemical principles of extraction of aluminum , magnesium , zinc.

#### UNIT-5

Physico chemical principles of extraction of silver , sodium , chromium.

Inorganic materials of industrial importance-availability , forms , structures and modifications of silica , silicates , clays , mica , zeolite.

#### PRACTICALS

1. Simple laboratory techniques : crystallization , Fractional Crystallization , Distillation , Fractional Distillation , Boiling point diagram.
2. Extraction process : Phase Diagram , Portition Coefficient
3. Prepration of standard solutions Primary and secondary standards , Determination of  $H_2SO_4$  and  $H_3PO_4$  in a mixtures.
4. Calibration of thermometers.
5. Acquantance with safety measures in a laboratory , hazards of chemicals

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JIWAJI UNIVERSITY, GWALIOR

INDUSTRIAL CHEMISTRY

B.Sc. II SEMESTER

**Unit Operation and Material Balance**

**Unit-1**

**Distillation**-Introduction, Batch and continuous distillation, separation of azeotrops, plate columns and packed column.

**Evaporation**-Introduction, equipments-short tube(standard) evaporators, forced circulation evaporators, falling film evaporators climbing film(Upward flow) evaporators, wiped(agitated) film evaporators.

**Filtration**-Introduction, filter media and filter aids, equipments- plate and frame filter press, rotary drum filter, bag filter, centrifuge.

**Unit-2**

**Extraction**-Introduction, selection of solvents, equipments-spray column, packed column ,rotating disk column ,mixer settler.

**Drying**-Introduction, free moisture, bound moisture , drying curve, equipments-tray dryer ,rotary dryer ,flash dryer, fluid bed dryer, drum dryer, spray dryer.

**Crystallization**-Introduction, solubility. super saturation, nucleation, crystal growth crystallizer, evaporator crystallizer, draft tube crystallizer.

**Unit-3**

**Heat Transfer**- Heat exchangers-Cell and tube types, finned tube heat exchangers, plate heat exchangers, and refrigeration cycles.

**Adsorption**- Introduction, Equipments-Packed columns, spray column, bubble, packed bubble column, mechanically agitated contactors.

**Mixing**- Introduction, mixing of liquid-liquid, solid- solid, liquid-solid systems.

**Fluid Flow**- Fans, blowers, compressors, vaccum pumps, ejectors, centrifugal pump and gear pump.

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#### Unit-4

**Boilers-** Types of boilers and their functioning.

**Water-** Specifications for industrial use, various water treatments.

**Steam-** Generation and use of steam.

**Air-** Specifications for industrial use, processing of air.

#### Unit-5

**Material balance without chemical reactions-** Flow diagram for material balance, simple material balance with or without recycle or bypass for chemical engineering operations such as distillation, absorption, crystallization, evaporation and extraction.

**Material balance involving chemical reactions-** Concepts of limiting reactants, conversion, yield, liquid phase reaction, with or without recycle or bypass.

**Energy balance-** Heat capacity of pure gases and gaseous mixtures at constant pressures, sensible heat changes in liquids, enthalpy changes.

#### PRACTICALS

1. Depression and elevation in b.p / m.p of solids and liquids.
2. Chromatography – column , paper , thin chromatography
3. Ore analysis - Dolomite , limestone , calcite analysis of alloys such as Cupre nickel
4. Determination of physical constants

Refractive index , surface tension ,( effect of surfactants on surface tension , viscosity of fluids , polymer solution , effect of additives on viscosity ,optical rotation.

5. Study experiments / demonstration experiments.

*C. S. Kulkarni*      *S. P. Patil*      *S. H. Menon*

JIWAJI UNIVERSITY GWALIOR

INDUSTRIAL CHEMISTRY

B.Sc. III SEMESTER

**Material Science, Measurement, Accuracy and Environmental Chemistry**

**UNIT – 1**

**Metals and alloys-** Mechanical, chemical applications of important metals and their alloys – iron Copper, Aluminium , Lead , Nickel , Titanium.

**Cement-** Types of cements, composition, manufacturing process, setting of cement.

**Ceramics -** Introduction, types, manufacturing process, applications, refractories.

**Glass-** types, composition, manufacturing process, physical and chemical properties, application

**Corrosion-** types of corrosion relevant to chemical industry, mechanism and preventive methods.

**UNIT-2**

**Temperature-** Glass thermometers, bimetallic thermometers, pressure spring thermometers, vapour filled thermometers, resistance thermometers, radiation pyrometers.

**Pressure -** manometer , barometer , borden pressure gauge , bellow type , diaphragm type , pressure gauges , macleod gauges , pirani gauges .

**UNIT – 3**

**Liquid level -** Direct – indirect liquid level measurement , float type liquid level gauge , ultrasonic level gauge , bubbler system.

**Density measurement-** Introduction and equipments to determine density (pycnometer , density bottle ).

**Viscosity measurement:** Introduction, capillary viscometer (Ostwald U-tube and suspended level viscometer) , falling sphere viscometer.

**UNIT – 4**

**Environmental segments and natural cycle-** Atmosphere, hydrosphere, lithosphere, biosphere, hydrological cycle, oxygen cycle, nitrogen cycle.

Pollutants and their statutory limits ,pollution evaluation methods.

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**Air pollution-** various pollutants – carbon monoxide, nitrogen oxide, hydrocarbons, sulphur dioxide, acid rain, radioactivity, Bhopal disaster.

#### UNIT – 5

**Water pollution-** organic pollutants – pesticides, organochlorine insecticides, detergents, radioactive materials, thermal pollution.

Radiation pollution, Green house effect.

Principles and equipments for Aerobic , anaerobic treatment , adsorption filtration , sedimentation.

Solid waste management , industrial safety , electrostatic precipitation , mist eliminators.

#### Practicals

**Unit process-** one to two examples of each of the following unit processes

Nitration , Sulphonation , Friedal crafts reaction ,

Esterification ,Hydrolysis, Oxidation ,

Halogenation ,Chlorosulphonation ,

Reduction , Polymerization , reaction of diazonium salt.

Instrumental methods of analysis –Use of Colourimeter ,pH meter

,potentiometer ,Conductometer ,Refractometer ,Polarimeter

Material testing: Testing of alloys , identification of plastics /rubber ,

estimation of yeild point ,Youngs Modulus ,flaredness ,

optical ,thermal , mechanical and electrical properties.

Volumetric analysis – Acidity and alkalinity of tap water.

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JIWAJI UNIVERSITY, GWALIOR

INDUSTRIAL CHEMISTRY

B.Sc. IV SEMESTER

Unit Process in Organic Synthesis and Polymer Science-I

UNIT-1

**Nitration-** Introduction, nitrating agent and mechanism of nitration processes such as nitration of paraffinic hydrocarbons, benzene to nitro benzene and m-dinitro benzene, chlorobenzene into o- and p- nitrochlorobenzene, acetanilide to p- nitro acetanilide, toluene, continuous and batch nitration.

**Halogenation-** Introduction, mechanism, kinetics, reagents, halogenations of aromatic side chain and nuclear halogenations, commercial manufacture of chlorobenzene, chloral, monochloroacetic and chloromethane, dichlorofluoromethane

**Sulphonation-** Introduction, sulphonating agents, chemical and physical reactors in sulphonation, kinetics, mechanism, commercial sulphonation of benzene, naphthalene, alkyl benzene, batch and continuous sulphonation

UNIT -2

**Amination by reduction-** introduction, method of reduction metal and acid catalytic, sulfide, electrolytic, metal and alkali sulphites, metal hydrides, sodium metal, concentrated caustic aniline, m-nitro aniline, p- amino phenol

**Amination by aminolysis-** introduction, aminating agents, factors affecting.

**Oxidation-** introduction, types, oxidising agents, kinetics and mechanism of oxidation of organic compounds, liquid phase oxidation, vapour phase oxidation, commercial manufacturing of benzoic acid, acetaldehyde, acetic acid

UNIT-3

**Hydrogenation-** introduction, kinetics, thermodynamics, catalysts, hydrogenation of vegetable oils, manufacture of methanol from carbon monoxide and hydrogen, hydrogenation of acids and esters to alcohols.

**Alkylation-** Introduction, types, alkylating agents, thermodynamics and mechanism, manufacture of alkyl benzene (for detergent manufacture), ethyl benzene, phenyl ethyl alcohol, N-alkyl anilines (mono and dimethyl and ethyl aniline)

**Esterification-** Introduction, hydrodynamics, kinetics, 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.

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**Hydrolysis-** introduction, hydrolysing agent, kinetics, thermodynamics and mechanism.

#### UNIT-4

Brief history of macromolecular science , general characteristics of polymers in comparison with common organic compounds , nomenclature ,distinct between plastics , elastomers and fibres

Natural polymers; cellulose, gums, resin and shellac

#### UNIT-5

**Types of polymers:** thermoplastics and thermosetting, functionality concept, concept of crosslinking linear branched and cross linked polymers.

**Types of Polymerization:** Addition, condensation, ionic, coordination polymerization, mechanism- initiation , propagation, and termination processes, initiator, inhibitors. Mechanism of ionic polymerization.

**Method of polymerization:** Bulk , suspension , emulsion , solution, Necessity of copolymers and copolymerization. Block and graft copolymers.

#### Practicals

1. Determination of flash point and ignition points of liquids
2. Water analysis – solid content, hardness and other tests as per industrial specification.
3. Flow measuring devices – floats
4. Monographs of representative raw materials such as sulphuric acid , toluene , sodium carbonate , sodium hydroxide , carbon tetrachloride benzoic acid
5. Limit test for heavy metals Pb ,As , Hg , Fe , and ash content
6. Determination of total hardness of tap water

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JIWAJI UNIVERSITY GWALIOR

INDUSTRIAL CHEMISTRY

B.Sc. V SEMESTER

Chemical Process Economics, Industrial Organization and Polymer Science-II

UNIT-1

**Financial management-** Concept, definition, types of capital, method employed for the estimation of capital, working capital, factors affecting requirement of the working capital.

**Cost accounting-** Introduction, elements of cost accounting, types of cost, factors involved in project cost estimation.

**Sales and marketing management-** Introduction, sales management, sales organization, function of sales department, selling concept vs marketing concept ,marketing management and its functions.

UNIT-2

**Depreciation-** Definition and concept, causes of depreciation, method of calculating depreciation such as straight line method , reducing balance method , repair provision method and annuity method.

**Breakeven analysis-;** Concept, importance and scope of breakeven analysis, calculation of breakeven point, breakeven chart.

**Inventory control and management-:** introduction, inventory classification, inventory management, functions of inventories.

**Plant location-** Concepts and factors governing plant location, rural vs urban sites.

UNIT-3

**Material management-** Introduction, function, objectives of material management, purchasing or procurement, purchase organization, buying techniques.

**Management concept-** Concept of scientific management in industry, function of management, decision making, planning, organizing, directing and control.

**Industrial management:** types of management, management development, management information system, application of management information system.

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#### UNIT-4

Detailed study of the following thermosetting polymers with reference to synthesis, chemistry, properties and applications – phenol formaldehyde resins, amino resins, Urea – formaldehyde resin, metamine formaldehyde resins, polyurethanes.

Detailed study of the following thermosetting polymers with reference to synthesis, chemistry, properties and applications —Epoxy Resins- grades of epoxy resins, Curing process and its importance with mechanism.

Poly carbonates, silicones

**Elastomers**– poly isoprene, poly butadiene, neoprene

Detailed study of the following thermosetting polymers with reference to synthesis, chemistry, properties and applications –polyolefins – poly ethylene, HDP, LDP, LLDP, polypropylene.

#### UNIT-5

Detailed study of the following thermosetting polymers with reference to synthesis, chemistry, properties and application – ethylene, propylene, copolymers.

Polyvinylchloride-Grades of PVC, teflon

Polystyrene- homopolymers, copolymers such as SBR, ABS, SAN.

Vinyl polymers\_ Poly vinyl acetates and its modifications like PVA, PVB and polyacetals.

#### Practicals

1. Determination of strength of  $\text{CuSO}_4$  iodometrically in industrial sample using this solution.
2. Preparation of Urea – Formaldehyde resin.
3. Preparation of Phenol – Formaldehyde resin
4. Separation of mixture by paper chromatography
5. Analysis of functional group present in industrial raw material
7. Purification of given sample by distillation.
8. Preparation of Rose water by steam distillation

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JIWAJI UNIVERSITY GWALIOR

INDUSTRIAL CHEMISTRY

VI SEMESTER

Industrial Chemical Analysis and Polymer Science- III

UNIT-1

**Reliability of analytical data-** Error in chemical analysis, classification of Errors ,determining the accuracy of methods , improving the accuracy of analysis , statistical analysis, rejection of results ,presentation of data

**Sampling-** Sampling procedures , sampling of bulk material, techniques of sampling solids ,liquids and gases ,collection and processing of data.

UNIT- 2

**UV-Visible Spectroscopy-** Theory, instrumentation, Woodward and Fieser Rules for calculating  $\lambda_{max}$ , applications

**IR spectroscopy-** Theory, instrumentation and applications.

**Atomic Absorption Spectroscopy-** Theory, instrumentation and applications.

**Flame Photometry-:** Theory, instrumentation factor affecting and applications.

UNIT-3

**Chromatographic techniques-** Introduction, principles, methods and applications of paper, TLC, column and ion chromatography.

**Gas chromatography-** Principles, instrumentation and applications

**High Performance Liquid Chromatography-** Principles, instrumentation and applications.

UNIT -4

**Polyamines-** Nylon-6 ,Nylon-66 other nylon polyethers and polyesters , terephthlates.

**Molecular weight and molecular weight distribution-** Number , weight , viscosity average, molecular weight of polymers, method of determining molecular weights ,practical significance of molecular weight , distribution size of polymers.

Introductory concept of kinetics of polymerization and Carothers relation.

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Glass state, Glass transition temperature, TGA, factors affecting GTT, Crystallization in polymers

#### UNIT-5

Viscosity, solubility, optical properties, electrical properties, thermal properties, mechanical properties of polymers.

Degradation of polymers by thermal, oxidative, mechanical and chemical methods.

**Polymer processing**– compression moulding casting, extrusion, fibre spinning, injection-moulding, thermoforming, Vulcanization of elastomers, polymer industries in India.

#### Practicals

1. Determination of saponification value of an oil or fat.
2. Determination of iodine value of an acid / fat / ester.
3. To prepare cellulose from sugar cane waste / cotton clothes
4. To prepare soap from oil.
5. To determine the concentration of given sample ( $\text{KMnO}_4$ ) by colorimeter.
6. To determine the Max. Wavelength of given sample by colorimeter.
7. Separation of mixture by Thin Layer Chromatography.

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