

# SAURASHTRA UNIVERSITY



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FOUR STAR

( Accredited by NAAC )

COURSE (CBCS) DETAILS

OF

Sem – III and Sem- IV

S.Y. B.Sc.

INDUSTRIAL CHEMISTRY

( In Force From June – 2011 )

SAURASHTRA UNIVERSITY

UNIVERSITY CAMPUS

RAJKOT-5

( GUJARAT ) ( INDIA )

# SAURSHTRA UNIVERSITY

RAJKOT



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( By NAAC )

## ***S.Y.B.Sc. SYLLABUS***

## **INDUSTRIAL CHEMISTRY**

SEMESTER – III

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PAPER No: BSIC 301

SEMESTER – IV

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PAPER No: BSIC 401

IN FORCE FROM JUNE – 2011

**SAURASHTRA UNIVERSITY**  
SECOND YEAR B.Sc. (INDUSTRIAL CHEMISTRY)  
Syllabus Of BSIC – 301 (INDUSTRIAL CHEMISTRY)  
(Effective from June - 2011)

**Semester – III**

**Unit 1**

**1.0 Metals, Alloys and Corrosion**

**Metals and Alloys:**

Introduction,

Various mechanical properties viz

Elasticity, Plasticity, Toughness, Resilience, Tensile Strength, Yield Strength,  
Impact Strength, Ductility, Malleability, Brittleness, Hardness, Fatigue, Creep,  
Wear Resistance,

Factors affecting mechanical properties,

Effect of low temperature and high temperature on mechanical properties of metals.

Classification of metals and alloys,

Purpose of alloying,

Steel and Stainless steel,

Copper and its alloys: Brass, Bronze,

**Corrosion:**

Introduction, Rusting, Causes of corrosion,

Classification of corrosion, Dry corrosion or direct chemical corrosion,

Wet corrosion or electrochemical corrosion,

Liquid metal corrosion, Oxidation corrosion,

Pilling-Bedworth rule, Corrosion by other gases,

Hydrogen embrittlement, Decarburation,

Electrochemical series, Galvanic series,

Factors influencing corrosion,

Mechanism of wet corrosion by

Evolution of H<sub>2</sub> gas, Absorption of O<sub>2</sub> gas.

Various types of corrosion,

Galvanic corrosion, Concentration cell corrosion, Differential cell corrosion,

Atmospheric corrosion, Stray current corrosion, Underground or soil corrosion,

Microbiological corrosion, Uniform corrosion, Pitting corrosion, Stress corrosion,

Erosion corrosion, Fretting corrosion, Cavitation corrosion, Crevice corrosion,

Corrosion control and protection techniques,

Proper designing of materials,

Use of highly pure metals, Use of metal alloys,

Use of special heat treatments, Cathodic protection,

Super imposition of impressed current, Sacrificial anode,

Use of inhibitors,

Modifying the environment,

Use of protective surface coatings.

Metallic coatings,

Anodic coating, Cathodic coating, Hot dipping, Metal spraying,

Electroplating, Galvanizing, Cladding, Vapor plating, Cementation,

Inorganic coating,

Phosphate coating, Chromate coating, Chemical oxide coating,

Vitreous coating,

Organic coating,  
Paints, Varnishes, Lacquers, Shellac, Emulsion paints, Enamels,  
Organic linings (rubber and plastics), Distempers, Cement paints.

## **2.0 Polymer & Composite Materials**

### **POLYMERS:**

Introduction,  
Definition of monomer, polymer, polymerization, degree of polymerization,  
Types of polymers, High polymer, Oligo polymer, Macromolecules, Atactic polymer,  
Isotactic polymer, Syndiotactic polymer,  
Classification of polymers,  
On the basis of occurrence, On the basis of structure,  
On the basis of constituents, On the basis of polymerization process,  
On the basis of thermal behavior,  
Polymer processing,  
Compounding, Moulding, Compression moulding, Transfer moulding,  
Injection moulding, Extrusion moulding, Blow moulding, Casting, Drawing,  
Rolling,  
Applications of polymers.

### **COMPOSITE MATERIALS:**

Introduction,  
Classification of composite materials  
Particulate composite materials,  
Particle strengthen composites, Dispersion strengthen composites,  
Fiber reinforced composites,  
Fiberglass reinforced composites, Fiber glass wool,  
Structural composites,  
Laminar composite materials, Sandwich composite materials.

## **3.0 Cement & Ceramics**

### **CEMENT:**

Introduction,  
Composition of cement, Functions of ingredient of ordinary cement,  
Manufacturing of ordinary cement  
Dry process, Wet process,  
Advantages and disadvantages of both the processes,  
Uses of cement,  
Various types of cement,  
Acid resistant cement, Blast furnace cement, Colored cement, Expanding cement,  
High alumina cement, Hydrophobic cement, Low heat cement, Pozzolana cement,  
Quick setting cement, Rapid hardening cement, Sulphate resisting cement,  
White cement, Additives of cement, Accelerators, Air entrapment agents,  
Retarders, Water repelling agents, Workability agents, Natural cementing  
materials,  
Setting and hardening of cement.

### **CERAMICS:**

Introduction, Raw materials of ceramic, Types of ceramic,  
Whitewares, Manufacturing of whitewares, Glazing, Method of glazing, Salt glazing,  
Liquid glazing,  
Structural clay products, Refractory materials, Uses of refractory materials,  
Manufacturing of refractories, Properties of refractories, Classification of refractories,  
Various uses of refractory materials, Vitreous Enamel,

## Unit 2

### 1.0 Fundamentals of Environment

Introduction and Definition of Environment,  
Types of environment,  
Segments of Environment,  
Introduction and Definition of Ecosystem and Ecology,  
Classification of Ecosystem and Ecology,  
Introduction of various Natural cycles of environments like  
Hydrological cycle,  
Nitrogen cycle,  
Phosphate cycle,  
Sulphur cycle,  
Oxygen cycle,

### 2.0 Environmental Pollution, Pollutants and their Classification

Introduction and Definition of Pollution and Pollutants,  
Types of Pollutions,  
Classification of pollutants,  
Introduction and Definition of Air pollution,  
Various sources of Air Pollution,  
Classification of Air pollutants,  
Sources, effects, reactions and control of some specific pollutants like  
Oxides of sulphur,  
Oxides of nitrogen,  
Oxides of carbon,  
Particulate pollutants,  
Photochemical smog,  
Green house effects.

### 3.0 Analysis of air pollutants

Analysis of various Air pollutants,  
Measurement of air quality,  
Air pollution control methods and equipments like

- gravitational settling chamber,
- cyclone separator,
- fabric filter system,
- electrostatic precipitator,
- wet scrubber,
- spray tower,
- centrifugal scrubber,
- plate and packed column,
- venturi scrubber,

Absorption of Air pollutants by liquids and solids,  
Combustion.

### 1.0 Sulphonation & Hydrolysis

#### **SULPHONATION:**

Definition,  
Sulfonating agents,  
Chemical factors,  
Physical factors,  
Sulphonation process of benzene,  
Sulphonation process of naphthalene,  
Sulphonation process of dodecyl benzene,

#### **HYDROLYSIS:**

Definition,  
Hydrolyzing agents,  
Chemical factors,  
Physical factors,

### 2.0 Oxidation & Hydrogenation

#### **OXIDATION:**

Introduction,  
Types of oxidation reactions,  
Various oxidizing agents,  
Chemical factors,  
Physical factors,  
Manufacturing process of acetic acid,  
Manufacturing process of acetaldehyde,  
Manufacturing process of benzoic acid,  
Manufacturing process of phthalic anhydride,  
Manufacturing process of maleic anhydride,  
Manufacturing process of acrolein.

#### **HYDROGENATION:**

Introduction,  
Various methods of reduction,  
Chemical factors,  
Physical factors,  
Various hydrogenating catalyst,  
Hydrogenation process of vegetable oils,  
Synthesis process of methanol,  
Reforming process,

### 3.0 Halogenation

Definition,  
Types of halogenation reactions,  
Various halogenating agents,  
Chemical factors,  
Physical factors,  
Manufacturing process of mono chloro acetic acid,  
Manufacturing process of sodium mono chloro acetate,  
Manufacturing process of chloral,  
Manufacturing process of chloro benzene,  
Chlorination of methane.

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**Semester – IV**

**Unit 1**

**1.0 Glass**

Introduction,  
Applications of glass, Composition of glass, Manufacturing of glass,  
Flow diagram of glass manufacturing,  
Melting of charge by  
Pot furnace, Tank furnace,  
Fabrication of an article,  
Blowing, Casting, Drawing, Pressing, Rolling, Spinning,  
Annealing the article formed,  
Flue treatment, Oven treatment,  
Finishing treatments,  
Bending, Cutting, Opaque making, Silvering,  
Types and application of glasses,  
Soda lime glass or soft glass, Potash lime glass or hard glass, Lead glass or Flint glass, Borosilicate glass or Pyrex glass or Gena glass, Alumino silicate glass, 96% silica glass, 99.5% silica glass or Vitreosil, Safety glass, Optical or Crookes glasses, Polycrystalline glass or Pyroceram, Toughened glass, Insulating glass, Wired glass, Laminated glass, Glass wool, Photosensitive glass, Photo chromic glass, Fiber glass.

**2.0 Instrumentation: Temperature and Viscosity**

Introduction,  
Types of measurement: Direct measurement, Indirect measurement,  
Functions of measuring instruments,  
Elements of instrument,  
Classification of measuring instrument,  
- According to operation,  
- According to the source of power,  
- According to the arrangement,  
Characteristics of an instrument: Static characteristics and Dynamic characteristics,

**Temperature Measurement:**

Temperature scale,  
Principle, construction and working of  
- Constant volume gas thermometer,  
- Glass thermometer,  
- Bimetallic thermometer,  
- Pressure spring thermometer,  
- Vapor actuated thermometer,  
- Pneumatic balance pressure thermometer,  
- Resistance thermometer,  
- Industrial resistance thermometer bulbs (RT bulbs),

Radiation temperature measurements,

Vacuum thermocouple, Balometer,

Laws of radiation,

Principle, construction and working of

- Radiation pyrometers,
- Photoelectric pyrometer,
- Optical pyrometer,

**Viscosity measurements:**

Introduction,

Principle, construction and working of

- Orifice type viscometer,
- Falling sphere viscometer,
- Rotational viscometer,

### **3.0 Instrumentation: Pressure and Liquid level**

#### **Pressure measurement:**

Introduction,

Liquid column manometer:

- U-tube manometer, Inclined manometer, Well type manometer,
- Ring type manometer,

Barometer,

Bourdon gauge, Bellow gauge, Diaphragm gauge, McLeod gauge, Thermal conductivity gauge, Pirani gauge, Thermocouple gauge

#### **Liquid level measurement:**

Introduction,

Methods of liquid level measurement

Direct methods

- Hook type level indicator,
- Sight glass,
- Float type level indicator,

Indirect methods

- Pressure gauge method:  
Bubbler system, Diaphragm box system, Air-trap system,
- Level measurement in pressure vessels
- Radiation level indicator
- Ultrasonic method for level measurement,

#### **Density measurement:**

Liquid level method of measuring specific gravity or density,

Displacement meter for measuring specific gravity or density,

Hydrometer,

## **Unit 2**

### **1.0 Water pollution**

Introduction and Definition of Water Pollution,

Causes of water pollution,

Classification of water pollution,

Main Sources of water pollution like

- sewage and domestic waste,
- industrial effluent,
- fertilizers,
- detergents,
- toxic metals,
- siltation,
- thermal pollutants,
- radioactive materials,
- natural sources

Introduction and Definition of Water Pollutants,

Effects of various water pollutants on men, materials and plants,

Classification of water pollutants,

Analysis of sewage water,

Waste water treatment like

- screening,
- sedimentation,
- floatation,
- activated sludge treatment,
- trickling filter,
- oxidation pond,
- aerated lagoons,
- anaerobic lagoons,
- septic tanks,
- In Hoff's tanks,



## **2.0 Solid Waste Management**

Introduction and Definition of Solid Waste Management,  
Various Source of solid waste, Classification of solid waste,  
Various Methods of collection, transfer and disposal of solid waste,  
Recovery and recycling of various solid wastes like

- Paper
- Glass
- Metal
- plastic

## **3.0 Various pollutions**

Types, sources, effects and control of various pollutions like  
radiation pollution,  
thermal pollution,  
pesticide pollution,  
noise pollution,

## **Unit 3**

### **1.0 Nitration**

Definition,  
Various nitrating agents,  
Chemical factors and Physical factors,  
Manufacturing process of nitrobenzene,  
Manufacturing process of m-dinitrobenzene,  
Nitration process of chlorobenzene,  
Nitration process of acetanilide,  
Nitration process of toluene,

### **2.0 Alkylation and Esterification**

#### **Alkylation:**

Definition,  
Types of alkylation reaction,  
Types of alkylating agents,  
Chemical factors and Physical factors,  
Manufacturing process of alkyl aryl detergents,  
Manufacturing process of ethyl benzene,  
Manufacturing process of dimethyl aniline,  
Manufacturing process of phenyl ethyl alcohol,

#### **Esterification:**

Definition,  
Types of Esterification reaction,  
Types of Esterification agents,  
Chemical factors and Physical factors,  
Manufacturing process of cellulose acetate,  
Manufacturing process of vinyl acetate,  
Manufacturing process of ethyl acetate,  
Manufacturing process of dioctyl phthalate,

### **3.0 Amination**

#### **Amination by reduction:**

Definition,  
Types of amination reaction and Aminating agents,  
Chemical factors and Physical factors,  
Manufacturing process of aniline,  
Manufacturing process of m-nitroaniline,

#### **Amination by ammonolysis:**

Definition,  
Types of amination reaction,  
Aminating agents, Chemical factors and Physical factors.

## **BOOKS FOR REFERENCES:**

- 1) Pollution control in chemical and allied industries by S.P.Mahajan.
- 2) Pollution control in industries. A series of books by H.R. Jones.
- 3) System's approach to air pollution control by R.J. Bibbero and I.G.Young.
- 4) Air pollution Volume I, II, III & IV, Editor A.C. Stern, Academic press, New York.
- 5) Gas purification process for air pollution control by G. Nonhebel, Newnes, Butterworths, London.
- 6) Air pollution technologies by Painter D. E. Reston publishing company.
- 7) Effluent treatment in process industries – Instrumentation of chemical engineering.
- 8) Effluent treatment and waste disposal – Instrumentation of chemical engineering.
- 9) Effluent treatment and disposal – Instrumentation of chemical engineering.
- 10) Industrial instrumentation by D.P. Eckman, John – Wiley's and sons.
- 11) Applied instrumentation in process industries, Volume I, II, & III, W.G. Andrews, Gulf publication.
- 12) Instrumentation and control for the process industries by S. Borer, Elsevire applied science publisher.
- 13) Chemical engineers handbook, by J.H. Perry and D. Green, McGraw Hill publishing company, New York.
- 14) Industrial chemistry by B.K. Sharma.
- 15) Environmental chemistry by B.K. Sharma.
- 16) Chemical process industries, R.N. Shreve's, McGraw Hill.
- 17) Applied organic chemistry by E. Kilner and Samuel.
- 18) Unit process in organic synthesis by P.H. Groggines, McGraw Hill Kogakusin Limited.
- 19) Industrial chemicals. Faith et al; Wiley international, New York.
- 20) Outline of chemical technology, G.E. Dryden; East West press New Delhi.
- 21) Introduction to material science and engineering, K.M. Rells, T. Courtney and J. Wulff; Wiley eastern private limited, New Delhi.
- 22) Heavy organic chemicals by A.J. Saite, Paragon press, UK.
- 23) Textbook of practical chemistry by Vogel.
- 24) Environmental pollution control by C.S. Rao.
- 25) Environmental chemistry by Hooda.
- 26) Introduction to chemical engineering by Badger and Bachero.
- 27) Material Science mini refresher by H.S. Bawa, Tata publisher India.
- 28) Environmental chemistry by Banerji.
- 29) Organic chemistry by Mcmurry.
- 30) Organic chemistry by Carey.
- 31) Organic synthesis by Smith.
- 32) Organic chemistry by Clayden.
- 33) Reaction mechanism by Chattopadhyay.
- 34) Elements of metallurgy by Dr. D. Swarup, Varanasi.
- 35) Textbook of polymer science, Billmeyer, Johnwill.
- 36) Advance engineering chemistry comprehensive by Dr. Manas Ranjan Senapati, Laxmi publication (P) Limited.
- 37) A textbook of engineering chemistry by S.S. Dara, S. Chand and company, New Delhi.
- 38) Polymer Science by Govarikar.
- 39) Introduction to polymer chemistry by G.S. Sharma.
- 40) Advance chemistry by Philips.
- 41) Engineering chemistry by Jain and Jain.
- 42) Experimental organic chemistry, Williams.
- 43) Practical chemistry by Pandey.

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**PRACTICALS**

**\* Semester – III:**

- \* One step organic preparation such as
  - 1) Aniline to sulfanilic acid.
  - 2) Benzoin to benzil.
  - 3) Acetanilide to p-bromoacetanilide.
  - 4) p-bromoacetanilide to p-bromoaniline.
  - 5) Copper oxide to copper sulphate.
  - 6) Aniline to diazoaminobenzene.
  - 7) Benzoic acid to m-nitrobenzoic acid.
  - 8) Aniline to phenylazo-  $\beta$  -naphthol.
  - 9) Maleic acid to fumeric acid.
  - 10) p-nitrotoluene to p-nitrobenzoic acid.
  - 11) p-nitroacetanilide to p-nitroaniline.
  - 12) Benzene to nitrobenzene.
  - 13) Anthranilic acid to o-chlorobenzoic acid.
  - 14) Naphthalein to  $\alpha$ -nitronaphthalein.

**\* Semester – IV:**

- \* Water analysis and instrumental methods of analysis.
  - **Water analysis**
    - 1) To determine amount of non-volatile dissolved solids.
    - 2) To determine alkalinity.
    - 3) To determine acidity.
    - 4) To determine hardness.
    - 5) To determine chloride.
  - **Instrumental methods of analysis**
    - 1) Conductometric titration.
    - 2) pH metric titration.
    - 3) Colorometric titration.
    - 4) Polarimeter.
    - 5) Potentiometric titration.
    - 6) Refractometer.

**\* Semester – III:**

BSIC – 301 (Theory + Internal+ Practical) (70 + 30 + 25)  
&  
BSICP -302

**» Theory:**

Paper carries 70 Marks  
Four Lectures / Week

**» Practical:**

Practical carries 25 Marks  
Two days / Week

- 1) Organic Preparation (20 Marks)
- 2) Viva (Written Question) (03 Marks)
- 3) Journal (02 Marks)

**\* Semester – IV:**

BSIC – 401 (Theory + Internal + Practical) (70 + 30 + 25)

&

BSICP -402

**► Theory:**

Paper carries 70 Marks

Four Lectures / Week

**► Practical:**

Practical carries 25 Marks

Two days / Week

4) Water Analysis (10 Marks)

5) Instrumentation (10 Marks)

6) Viva (Written Question) (03 Marks)

7) Journal (02 Marks)

<b>Paper No.</b>	<b>Subject per Semester</b>	<b>No. Of Paper</b>	<b>Theory Exam Time</b>	<b>Practical Exam hours</b>
<b>BSIC301 &amp; BSICP302</b>	<b>Industrial Chemistry</b>	<b>One</b>	<b>3 Hours</b>	<b>3.5</b>
<b>BSIC401 &amp; BSICP402</b>	<b>Industrial Chemistry</b>	<b>One</b>	<b>3 Hours</b>	<b>3.5</b>