

SAURSHTRA UNIVERSITY



ACCREDITED GRADE "A" BY NAAC

COURSE DETAILS OF S.Y. B.Sc.

SEMESTER – III
PAPER: BS-IC-301 (CBCS)
&
SEMESTER – IV
PAPER: BS-IC-401 (CBCS)

INDUSTRIAL CHEMISTRY
(In Force from June – 2017)

SAURASHTRA UNIVERSITY
UNIVERSITY CAMPUS
RAJKOT-5
(GUJARAT) (INDIA)

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CREDIT SYSTEM & MARKS OF SYLLABUS

Stream	Paper	Unit	Name of Unit	Credit	Lectures	Marks		
						External	Internal	
B.Sc. Sem-3 (UG) Paper- 301	BS-IC- 301 Credit (04)	1	Environment	0.8	12	70	14	30
		2	Environment and Unit Processes(Sulphonation& Hydrolysis)	0.8	12		14	
		3	Unit Processes (Oxidation, Hydrogenation & Halogenation)	0.8	12		14	
		4	Metals, Alloys and Corrosion	0.8	12		14	
		5	Cement & Ceramics	0.8	12		14	
	Total			04	60	100		
	BS-IC-P-302 Credit (02)		PRACTICAL BASED ON ORGANIC PREPARATION.		02	30	35	15
Total			02	30	50			
B.Sc. Sem-2 (UG) Paper- 401	BS-IC- 401 Credit (04)	1	Water pollution & Solid Waste Management	0.8	12	70	14	30
		2	Various pollutions and Unit processes (Nitration & Alkylation)	0.8	12		14	
		3	Unit processes (Esterification & Amination)	0.8	12		14	
		4	Instrumentation: Introduction, temperature, viscosity	0.8	12		14	
		5	Instrumentation: Pressure, Liquid level & Density	0.8	12		14	
	Total			04	60	100		
	BS-IC-P-402 Credit (02)		PRACTICAL BASED ON WATER ANALYSIS, PHYSICO-CHEMICAL EXERCISES.		02	30	35	15
Total			02	30	50			

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SECOND YEAR B.Sc. (INDUSTRIAL CHEMISTRY)
Syllabus of BS-IC-301 (INDUSTRIAL CHEMISTRY) (CBCS)
(Effective from June - 2017)

SEMESTER – III

UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)

Environment

1.1 Fundamentals of Environment

Introduction, Types of environment, Division of environment, Ecosystem and Ecology, Natural cycles of environments:
Hydrological cycle, Nitrogen cycle, Phosphate cycle, Sulphur cycle, Oxygen cycle

1.2 Environmental Pollution and its types

Classification of pollutants, Air pollution and its sources, Types of air pollutants, Various air pollutants,
Sources, effects, reactions and control of some specific pollutants on men, materials and plants:
Oxides of sulphur (SO_x), Oxides of nitrogen (NO_x),
Oxides of carbon (CO_x), Hydrocarbon, Particulate pollutants,
Photochemical smog, Green house effects.

BOOKS FOR REFERENCES(SEM-3-UNIT-1):

1. Pollution control in chemical and allied industries by S.P.Mahajan.
2. Environmental pollution control by C.S. Rao.
3. Pollution control in industries. A series of books by H.R. Jones.
4. Gas purification process for air pollution control by G. Nonhebel, Newnes, Butterworths, London.

UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)

Environment and Unit Processes (Sulphonation & Hydrolysis)

2.1 Analysis of various air pollutants

Pollutants like sulphur dioxide, carbon monoxide, oxide of nitrogen, hydrocarbons,
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 by liquids and solids, Combustion.

2.2 Unit Processes (Sulphonation & Hydrolysis)

SULPHONATION:

Definition,
Sulfonating agents,
Chemical factors,
Physical factors,
Outline of chemical kinetic, mechanism and thermodynamics,
Sulphonation process of benzene,
Sulphonation process of naphthalene,
Sulphonation process of dodecyl benzene,

HYDROLYSIS:

Definition,
Hydrolyzing agents,
Chemical factors,
Physical factors,
Outline of chemical kinetic, mechanism and thermodynamics.

BOOKS FOR REFERENCES (SEM-3-UNIT-2):

1. Air pollution technologies by Painter D. E. Reston publishing company.
2. System's approach to air pollution control by R.J. Bibbero and I.G. Young.
3. Unit process in organic synthesis by P.H. Groggins, McGraw Hill Kogakusin Limited.
4. Applied organic chemistry by E. Kilner and Samuel.

UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)

Unit Processes (Oxidation, Hydrogenation & Halogenation)

3.1 Oxidation & Hydrogenation

OXIDATION:

Introduction,
Types of oxidation reactions,
Various oxidizing agents,
Chemical factors,
Physical factors,
Outline of chemical kinetic, mechanism and thermodynamics,
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,
Outline of chemical kinetic, mechanism and thermodynamics,
Various hydrogenating catalyst,
Hydrogenation process of vegetable oils,
Synthesis process of methanol,
Reforming process

3.2 Halogenation

Definition,
Types of halogenation reactions,
Various halogenating agents,
Chemical factors,
Physical factors,
Outline of chemical kinetic, mechanism and thermodynamics,
Manufacturing process of mono chloro acetic acid,
Manufacturing process of sodium mono chloro acetate,
Manufacturing process of chloral,
Manufacturing process of chloro benzene,
Manufacturing process of freon-12,
Chlorination of methane.

BOOKS FOR REFERENCES (SEM-3-UNIT-3):

1. Chemical process industries, R.N. Shreve's, McGraw Hill.
2. Organic synthesis by Smith.
3. Organic chemistry by Clayden.
4. Unit process in organic synthesis by P.H. Groggines, McGraw Hill Kogakusin Limited.

UNIT 4 (CREDIT-0.8, LECTURES-12, MARKS-14)

Metals, Alloys and Corrosion

4.1 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, Effects of low 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.

4.2 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 H₂ gas, Absorption of O₂ 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.

BOOKS FOR REFERENCES (SEM-1-UNIT-4):

1. Material Science mini refresher by H.S. Bawa, Tata publisher India.

UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)

Cement & Ceramics

5.1 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.

5.2 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.

BOOKS FOR REFERENCES (SEM-1-UNIT-5):

1. Industrial chemistry by B.K. Sharma.

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SEMESTER – IV

UNIT 1 (CREDIT-0.8, LECTURES-12, MARKS-14)

Water pollution & Solid Waste Management

1.1 Water pollution

Introduction,

Causes of water pollution,

Types of water pollution,

Sources of water pollution like:

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

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

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

1.2 Solid waste management

Introduction,

Source and classification of solid waste,

Methods of collection, transfer and disposal of solid waste,

Recovery and recycling of waste,

- Paper, glass, metal, plastic

BOOKS FOR REFERENCES (SEM-IV-UNIT-1):

1. Solid Waste Management, D.J. Hagery et al., Van Nostrand Reinhold, 1973.
2. Waste Water Engineering Treatment Disposal Reuse, Metcalf and Eddy, 4th Edition, Tata McGraw Hill, 2003.
3. Integrated Solid Waste Management, George Tchobanoglous et al, 2nd Edition, McGraw Hill & Co, 1993.

UNIT 2 (CREDIT-0.8, LECTURES-12, MARKS-14)

Various pollutions and Unit processes (Nitration & Alkylation)

2.1 Various pollutions

Types, sources, effects and control of radiation pollution,
Types, sources, effects and control of thermal pollution,
Types, sources, effects and control of pesticide pollution,
Types, sources, effects and control of noise pollution.

2.2 Nitration

Definition,
Various nitrating agents,
Chemical factors and Physical factors,
Outline of chemical kinetic, mechanism and thermodynamics,
Manufacturing process of nitrobenzene,
Manufacturing process of m-dinitrobenzene,
Nitration process of chlorobenzene,
Nitration process of acetanilide,
Nitration process of toluene,
Definition of : DVS, Nitric ratio.

2.3 Alkylation

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

BOOKS FOR REFERENCES(SEM-IV-UNIT-2):

1. Noise Abatement, Duerden, Butterworth, 1970.
2. Industrial Pollution Control Handbook, Lund, H.F., 6th Edition, Vol.1, McGraw Hill, 1971.
3. Unit Processes in Organic Chemical Industries, Desikan and Sivakumar (Eds.), CEDC, IITM, 1982.

UNIT 3 (CREDIT-0.8, LECTURES-12, MARKS-14)

Unit processes (Esterification & Amination)

3.1 Esterification

Definition,

Types of Esterification reaction,

Types of Esterification agents,

Chemical factors and Physical factors,

Outline of chemical kinetics, mechanism and thermodynamics,

Manufacturing process of cellulose acetate,

Manufacturing process of vinyl acetate,

Manufacturing process of ethyl acetate,

Manufacturing process of dioctyl phthalate

3.2 Amination

Amination by reduction:

Definition,

Types of amination reaction,

Aminating agents,

Chemical factors and Physical factors,

Outline of chemical kinetics, mechanism and thermodynamics,

Manufacturing process of aniline,

Manufacturing process of m-nitroaniline,

Amination by ammonolysis:

Definition,

Types of amination reaction,

Aminating agents,

Chemical factors and Physical factors,

Outline of chemical kinetics, mechanism and thermodynamics

BOOKS FOR REFERENCES (SEM-IV-UNIT-3):

1. Organic synthesis by Smith.
2. Unit process in organic synthesis by P.H. Groggins, McGraw Hill Kogakusin Limited.
3. Organic chemistry by McMurry.

UNIT 4(CREDIT-0.8, LECTURES-12, MARKS-14)

4.1 Instrumentation: Introduction

Introduction, Types of measurement: Direct measurement, Indirect measurement, Functions of measuring instruments, Elements of instrument, Classification of measuring instrument, Characteristics of and instrument: Static characteristics and Dynamic characteristics.

4.2 Temperature Measurement

Temperature scale, Principle, construction and working of Constant volume gas thermometer, Principle, construction and working of Glass thermometer, Principle, construction and working of Bimetallic thermometer, Principle,

construction and working of Pressure spring thermometer, Construction of the element of measuring element: Thermometer bulb and well, Thermometer capillary and armour, Receiving element (Pressure spring), Recording (Indicating) element, 8 Principle, construction and working of Vapour actuated thermometer, Principle, construction and working of Pneumatic balance pressure thermometer, Resistance thermometer, Industrial resistance thermometer bulbs (RT bulbs), Radiation temperature measurements, Laws of radiation, Principle, construction and working of Radiation pyrometers, Vacuum thermocouple, Balometer, Principle, construction and working of Photoelectric pyrometer, Principle, construction and working of Optical pyrometer.

4.3 Viscosity measurements:

Introduction, Principle, construction and working of Orifice type viscometer, Principle, construction and working of Falling sphere viscometer, Principle, construction and working of Rotational viscometer.

BOOKS FOR REFERENCES (SEM-2-UNIT-4):

1. Industrial chemistry by B.K. Sharma.
2. Instrumentation and control for the process industries by S. Borer, Elsevier applied science publisher.
3. Chemical engineers handbook, by J.H. Perry and D. Green, McGraw Hill publishing company, New York.
4. Industrial instrumentation by D.P. Eckman, John – Wiley's and sons.

UNIT 5 (CREDIT-0.8, LECTURES-12, MARKS-14)

5.1 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, Ionization gauge, Measuring pressure in corrosive fluids: Single coil siphon, Diaphragm seal, Liquid seal, Purge system

5.2 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.

5.3 Density measurement

Liquid level method of measuring specific gravity or density, Displacement meter for measuring specific gravity or density, Hydrometer.

BOOKS FOR REFERENCES (SEM-2-UNIT-5):

1. Industrial chemistry by B.K. Sharma.
2. Instrumentation and control for the process industries by S. Borer, Elsevireapplied science publisher.
3. Chemical engineers handbook, by J.H. Perry and D. Green, McGraw Hill publishing company, New York.
4. Industrial instrumentation by D.P. Eckman, John – Wiley’s and sons.

5. B.SC. SEM-3 & SEM-4 PRACTICALS

SEMESTER III (BS-IC-P-302)

PRACTICAL BASED ON ORGANIC PREPARATION.

LIST OF PRACTICAL:

1. Preparation of Fumaric acid from Maleic acid.
2. Preparation of Benzil from Benzoin.
3. Preparation of m-nitro benzoic acid from Benzoic acid.
4. Preparation of p-nitro benzoic acid from p-nitro toluene.
5. Preparation of Diazo amino benzene from Aniline.
6. Preparation of Phenyl azo β -Naphthol from Aniline.
7. Preparation of p-bromo acetanilide from Acetanilide.
8. Preparation of α -Nitro naphthalene from Naphthalene.
9. Preparation of p-bromo aniline from p-bromo acetanilide.
10. Preparation of p-nitro aniline from p-nitro acetanilide.
11. Preparation of Sulfanilic acid from Aniline.

SEMESTER IV(BS-IC-P-402)

PRACTICAL BASED ON WATER ANALYSIS, PHYSICO-CHEMICAL EXERCISES.

LIST OF PRACTICAL:

1. Determination the amount of non-volatile dissolved solids in the given sample of water.
2. Determination of alkalinity of water sample in terms of carbonate, bicarbonate and hydroxide.
3. Determination of amount of chloride in given water sample.
4. Determination of hardness of a water sample.
5. Determination of the total acidity of the given water sample.
6. Determination of the normality of X-N CH₃COOH solution with the help of 0.5 N NaOH solution by using Conductivity meter.
7. Determination of the normality of X-N HCl solution with the help of 0.5 N NaOH solution by using Conductivity meter.
8. Determination of the normality of X-N HCl +CH₃COOH solution with the help of 0.5 N NaOH solution by using Conductivity meter.
9. Determination of the normality of X-N CH₃COOH solution with the help of 0.5 N NaOH solution by using pH meter.
10. Determination of the normality of X-N HCl solution with the help of 0.5 N NaOH solution by using pH meter.
11. Determination of the normality of X-N CH₃COOH solution with the help of 0.5 N NaOH solution by using Potentiometer.
12. Determination of the normality of X-N HCl solution with the help of 0.5 N NaOH solution by using Potentiometer.
13. Determination of the amount of Nickel with the dimethyl glyoxime.

14. Determination of the amount of Fe^{+3} present in given sample.
15. Determination of the amount of NO_2^- present in given sample.
16. Determination of the % concentration of given solution on basis of angle of rotation by using Polarimeter.

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Distillation assembly
2. Stoppered bottles
3. Titration glassware assembly
4. pH Meter
5. Potentiometer
6. Conductivity meter
7. Polarimeter
8. Colorimeter

SEMESTER – III:

BSIC – 301 (Theory + Internal Theory + Practical + Internal Practical) (70+30+35+15)
&
BS-IC-P -302

Theory:

Paper carries 70 Marks
Six Lectures/Week

Practical:

Practical carries 35 Marks
Two days/Week

- 1) Organic Preparation (35 Marks)

PAPER NO.	SUBJECT PER SEMESTER	NO. OF PAPER	THEORY EXAM TIME	PRACTICAL EXAM HOURS
BS-IC-301 & BS-IC-P-302	INDUSTRIAL CHEMISTRY	One	3 Hours	3

SEMESTER – IV:

BSIC – 401 (Theory + Internal Theory + Practical + Internal Practical) (70 + 30 + 35+15)
&
BS-IC-P-402

Theory:

Paper carries 70 Marks
Six Lectures/Week

Practical:

Practical carries 35 Marks

- Two days/Week
1) Water analysis (15 Marks)
2) Physico-chemical Exercises (20 Marks)

PAPER NO.	SUBJECT PER SEMESTER	NO. OF PAPER	THEORY EXAM TIME	PRACTICAL EXAM HOURS
BS-IC-401 & BS-IC-P-402	INDUSTRIAL CHEMISTRY	One	3 Hours	3