

**REVISED SYLLABUS OF B.Sc (Industrial Chemistry)  
UNDER CBCS FRAMEWORK WITH EFFECT FROM 2020-2021**

**PROGRAMME: THREE-YEAR B.Sc. (B.ScIndustrial Chemistry)**

*(With Learning Outcomes, Unit-wise Syllabus, References, Co-curricular  
Activities & Model Q.P.)  
For Five Courses of 1, 2, 3 & 4 Semesters)  
(To be Implemented from 2020-21 Academic Year)*

**B.Sc. Industrial Chemistry Revised Syllabus under CBCS  
w.e.f. 2020-21**

**Structure of Industrial Chemistry Core Syllabus under CBCS**

<b>YEAR</b>	<b>SEMESTER</b>	<b>COURSE</b>	<b>TITLE</b>	<b>MARKS</b>	<b>CREDITS</b>
<b>I</b>	<b>I</b>	<b>I</b>	Material & Energy balances and Utilities in Chemical Industry	100	04
			Practical-I	50	01
	<b>II</b>	<b>II</b>	Inorganic Materials	100	04
			Practical-II	50	01
<b>II</b>	<b>III</b>	<b>III</b>	Cosmetics, Fermentation, Food additives, Sugar and Industrial Pollution	100	04
			Practical-III	50	01
	<b>IV</b>	<b>IV</b>	Dyes, Drugs and Pharmaceuticals, Leather, Paper and Industrial waste management	100	04
			Practical-IV	50	01
	<b>IV</b>	<b>V</b>	Polymers and Instrumental methods of analysis	100	04
			Practical-V	50	01

## SEMESTER-I

### Course-I

#### MATERIAL & ENERGY BALANCES AND UTILITIES IN CHEMICAL INDUSTRY

60hrs (4 hours/week)

#### Course Outcomes

At the end of the course student will be able to

- CO1 Describe the distinction between Atomic weight, Molecular weight and Equivalent Weight.
- CO2 Write down the flow diagrams for chemical engineering operations.
- CO3 Describe heat capacities of gases and gaseous mixtures.
- CO4 Write down water treatment procedures for industrial use.
- CO5 Describe the types of boilers.
- CO6 Demonstrate knowledge acquired in steam generation.
- CO7 Write down compressors and blowers.
- CO8 Classify pumps based on their function.

#### Unit-1

12 hours

**Dimensions and units:** Basic Chemical Calculations -Atomic weight, molecular weight, equivalent weight, Mole, composition of (i) Liquid mixtures and (ii) gaseous mixtures. Ideal gas law, vapour pressure, Humidity and Saturation.

#### Unit-II

14 hours

**Material Balance without Chemical Reactions:** Flow diagram for material balance, simple material balance with or without recycle or by-pass for chemical engineering operations such as distillation, absorption, crystallization, evaporation and extraction.

**Material Balance involving chemical reactions:** concept of limiting reactant, conversion, yield, selectivity, and liquid phase reaction, gas phase reaction with or without recycle or bypass.

#### Unit-III

10 hours

**Energy Balance:** Heat capacity of pure gases and gaseous mixtures at constant pressures, sensible heat changes in liquids, Enthalpy changes.

#### Unit-IV

12 hours

## Utilities in Chemical Industry

- a) **Boilers:** Types of boilers and their functioning
- b) **Water:** Specifications of industrial use, various water treatments.
- c) **Steam:** Generation and use.
- d) **Air:** Specification of industrial use, processing of air

## Unit-V

**12 hours**

### Fluid flow and Pumps

**Fluid flow:** Fans, blowers, compressors, vacuum pump, ejectors.

**Pumps:** Reciprocating pumps, Gear pumps, centrifugal pumps.

### Co-curricular activities and Assessment Methods

1. **Assessment of Learning:** Summative assessment- Conduct of semester end exams.
2. **Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
3. **Assessment as learning:** Self-assessment-assignments, slip tests etc.,
4. **Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc., .**

## Laboratory Course –I

**50 Marks**

**Practical Paper- I (at the end of semester I) 30 hours (2 hours / week)**

### Course Outcomes

At the end of the course student will be able to

- CO1 Carry out the Quantitative analysis of calcium in lime stone.
- CO2 Determine the hardness of given water sample using EDTA.
- CO3 Determine COD and BOD of a given water sample.
- CO4 Find out the Percentage of available chlorine present in the bleaching powder.

1. Quantitative analysis of calcium in lime stone by complexometric titration.
2. Hardness of water by EDTA titration.
3. Determination of Chemical Oxygen Demand (COD)
4. Determination of Biological Oxygen Demand (BOD)
5. Percentage of available chlorine in bleaching powder

## Reference Books

1. B.I. Bhatt and S.M. Vora: *Stoichiometry*, Tata McGraw-Hill publishing Company Ltd, New Delhi.
2. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
3. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
4. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
8. S. C. Bhatia: *Chemical Process Industries*, Vol. I & II, CBS Publishers, New Delhi.
9. W. L. McCabe and J. C. Smith: *Unit Operations in Chemical Engineering*, Mc-Graw Hill Book Company, New York.
10. O. P. Vermani, A. K. Narula: *Industrial Chemistry*, Galgotia Publications Pvt. Ltd., New Delhi.
11. Water Analysis Hand Book – NEERI

**MODEL PAPER**  
**FIRST YEAR B.Sc., DEGREE EXAMINATION**  
**SEMESTER-I**  
**INDUSTRIAL CHEMISTRY Course-I: MATERIAL & ENERGY**  
**BALANCES AND UTILITIES IN CHEMICAL INDUSTRY**

Time: 3 hours

Maximum Marks: 75

**PART- A**

5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. How the equivalent weights of different compounds are calculated. Explain.
2. Explain in brief, the concept of limiting reagent.
3. Explain the flow diagram for material balance without recycle for crystallization
4. Write a note on sensible heats in liquids.
5. How enthalpy changes of gas mixtures are calculated. Explain.
6. Write a note on processing of air.
7. Describe in brief steam generation procedures.
8. Explain briefly about blowers.

**PART- B**

5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Explain with examples how v/v, w/v and w/w of liquid mixtures is calculated.  
(or)  
(b) Write notes on i) Humidity and ii) Saturation
10. (a) Explain the flow diagram for material balance with recycle for distillation.  
(or)  
(b) Explain the flow diagram for material balance with and without recycle for evaporation.
11. (a) Define heat capacity and explain in detail about heat capacity of pure gases at constant pressure.  
(or)  
(b) Explain in detail about heat capacity of mixture of gases at constant pressure.
12. (a) Describe in detail about various water treatment procedures.  
(or)  
(b) Write an essay on different types of boilers and their functioning.
13. (a) Explain in detail about i) compressors and ii) ejectors.  
(or)

(b) Explain in detail about i) Reciprocating pumps and ii) centrifugal pumps.

## **SEMESTER-II**

### **Course-II**

#### **INORGANIC MATERIALS 60hrs (4 hours/week)**

##### **Course Outcomes**

At the end of the course student will be able to

- CO1 Describe the composition of different types of glasses.
- CO2 Write down different types of ceramics and their uses.
- CO3 Describe the steps involved in the manufacturing of cement
- CO4 Write down manufacturing of different fertilizers
- CO5 Describe the classification of alloys
- CO6 Demonstrate the manufacture of steel.
- CO7 Describe the differences between paints and pigments
- CO8 Write down about different types of paints

##### **Unit-1**

**12 Hours**

##### **Silicate Industries-1**

**Glass:** Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

##### **Unit-2**

**14 Hours**

##### **Silicate Industries-2**

**1. Ceramics:** Important clays and feldspar. Ceramics-types, uses and manufacture. High technology ceramics and their applications.

**2. Cements:** Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

##### **Unit-3**

**10 Hours**

##### **Fertilizers**

Different types of fertilizers. Manufacture of the following fertilizers: Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphates; Polyphosphate, Super phosphate, Compound and mixed fertilizers, Potassium Chloride, Potassium sulphate.

#### **Unit-4**

**10 Hours**

##### **Alloys**

Classification of alloys, Ferrous and Non-Ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon, decarbonization, demagnetization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

#### **Unit-5**

**14 Hours**

##### **Surface Coatings**

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, modified oils, Pigments, toners and lake pigments, fillers, thinners, enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

##### **Co-curricular activities and Assessment Methods**

- 1. Assessment of Learning:** Summative assessment- Conduct of semester end exams.
- 2. Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
- 3. Assessment as learning:** Self-assessment-assignments, slip tests etc.,
- 4. Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc.**



## Laboratory Course –II

50 Marks

**Practical Paper- II (at the end of semester II) 30 hours (2 hours/week)**

### Course Outcomes

At the end of the course student will be able to

- CO1 Determine the free acidity in a given ammonium sulphate fertilizer
- CO2 Estimate calcium present in Calcium ammonium nitrate fertilizer.
- CO3 Carry out the analysis of cement
- CO4 Estimate phosphoric acid in superphosphate fertilizer.

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Analysis of Cement.

### Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
3. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
5. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
6. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
7. S. C. Bhatia: *Chemical Process Industries*, Vol. I & II, CBS Publishers, New Delhi.
8. O. P. Vermani, A. K. Narula: *Industrial Chemistry*, Galgotia Publications Pvt. Ltd., New Delhi.

**MODEL PAPER**  
**FIRST YEAR B.Sc., DEGREE EXAMINATION**  
**SEMESTER-II**  
**INDUSTRIAL CHEMISTRY Course-II: INORGANIC MATERIALS**

Time: 3 hours

Maximum Marks: 75

**PART- A**

5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Write a note on composition and properties of coloured glass.
2. Describe about important clays.
3. Write the applications of High technology ceramics.
4. What are quick setting cements? Explain briefly.
5. How do you distinguish compound fertilisers from mixed fertilisers? Explain briefly.
6. What are ferrous and non-ferrous alloys? Explain briefly.
7. Write a note on 'oil paints'.
8. Describe in brief about water paints.

**PART- B**

5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Explain the different steps involved in the manufacturing of glass.  
(or)  
(b) Describe the composition and properties of (i) Borosilicate glass (ii) Lead glass.
10. (a) What are ceramics? Write about different types of ceramics and their properties.  
(or)  
(b) Describe steps in the manufacturing of Portland cement.
11. (a) Explain about different types of fertilizers.  
(or)  
(b) Explain the manufacturing of (i) Urea and (ii) Super Phosphate
12. (a) Write a note on desulphurization and dephosphorisation of steel.  
(or)  
(b) Describe the composition and properties of different types of steels.

13. (a) What are metal coatings. Differentiate between electrolytic and electroless coatings.

(or)

(b) Explain in detail about special paints.

### **SEMESTER-III**

#### **Course-III**

#### **Cosmetics, Fermentation, Food additives, Sugar chemistry and Industrial Pollution**

**60hrs (4 hours/week)**

##### **Course Outcomes**

At the end of the course student will be able to

- CO1 Write down the preparation and uses of important cosmetics.
- CO2 Write down the preparation and uses.
- CO3 Differentiate the Aerobic and anaerobic fermentation processes.
- CO4 Describe the production of chemicals by fermentation process.
- CO5 Demonstrate the knowledge gained on Food additives.
- CO6 Write down the manufacture of Sugar.
- CO7 Write down the manufacture of Sucrose.
- CO8 Describe about different types of pollutants.

##### **Unit-1**

**12 Hours**

##### **Cosmetics and Perfumes**

A general study including preparation and uses of the following: Hair dye, hairspray, Shampoo, Suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, phenylethyl alcohol, Jasmone, Civetone, Muscone.

##### **Unit-2**

**12 hours**

##### **Fermentation Industries**

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin and Streptomycin, (iii) Lysine and Vitamin C.

##### **Unit-3**

**12 hours**

##### **Food additives**

A general study of food flavours- Flavoring agents: Vanilla, diacetyl, isoamyl acetate, limonene, ethylpropionate, allyl hexanoate;colours:Briliant blue FCF, fast green FCF, tertrazine, erythrosine, sunset yellow FCF and preservatives: Sodium carbonate, sodium benzoate, sorbic acid and artificial sweeteners.

#### **Unit-4**

**10 hours**

#### **Sugar Chemistry**

Introduction – Manufacture and recovery of cane sugar from molasses, manufacture of sucrose from beat root, testing and estimation of sucrose.

#### **Unit-5**

**14 hours**

#### **Industrial pollution**

Pollutants and their statutory limits

Air Pollution- various pollutants

Water pollution- Organic and Inorganic pollutants

Noise pollution

#### **Co-curricular activities and Assessment Methods**

- 1. Assessment of Learning:** Summative assessment- Conduct of semester end exams.
- 2. Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
- 3. Assessment as learning:** Self-assessment-assignments, slip tests etc.,
- 4. Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc., .**

### Laboratory Course –III

50 Marks

#### Practical Paper- III (at the end of semester III) 30 hours (2 hours/week)

##### Course Outcomes

At the end of the course student will be able to

- CO1 Carryout the analysis of a given oil and fat.
- CO2 Find out the adulterants in turmeric powder, milk and mustard oil.
- CO3 Estimate the glucose present in the food sample.
- CO4 Prepare Talcum powder, nail polish and face cream.

1. Analysis of oils and fats (iodine value, saponification value, acid value)
2. Testing of turmeric powder, milk and mustard oil for adulterants.
3. Estimation of glucose in food samples.
4. Preparation of talcum powder, nail polish and face cream

##### Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
3. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
4. *Practicals and Calculation in Engineering Chemistry* – S.S. Dara
5. A. K. De, *Environmental Chemistry*: New Age International Pvt, Ltd, New Delhi.
6. S.P. MAHAJAN: *Pollution control in process industries*, Tata McGraw-Hill publishing company limited, New Delhi.
7. C.k. Varshney: *Water Pollution and Management*, Wiley Eastern Limited, Chennai

**MODEL PAPER**  
**SECOND YEAR B.Sc., DEGREE EXAMINATION**  
**SEMESTER-III**  
**INDUSTRIAL CHEMISTRY Course-III: Cosmetics, Fermentation, Food**  
**additives, Sugar chemistry and Industrial Pollution**

Time: 3 hours

Maximum Marks: 75

**PART- A**

5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Write the uses of artificial flavours.
2. Describe the importance of rose oil.
3. Differentiate between aerobic and anaerobic fermentation.
4. Write a note on flavoring agent 'Vanilla'.
5. What are artificial sweeteners? Explain briefly.
6. Explain in brief the use of sodium carbonate as food preservative.
7. Describe in brief how sucrose is estimated.
8. Write a note on noise pollution.

**PART- B**

5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Write the preparation and uses of Sun-tan lotions and vanishing creams.  
(or)  
(b) What are essential oils? Describe the importance of Jasmone and Muscone.
10. (a) Explain the production of ethyl alcohol by fermentation process.  
(or)  
(b) Describe the production of Penicillin by fermentation process.
11. (a) Write a note on the following food colours i) Brilliant blue FCF and ii) Erythrosine  
(or)  
(b) Write a note on the following food preservatives i) sodium benzoate and ii) sorbic acid.
12. (a) Explain the manufacture of sugar from molasses.  
(or)  
(b) Explain the manufacture of sucrose from beat root.
13. (a) Write a note on organic pollutants in water.  
(or)

(b) Explain point and nonpoint sources of air pollution. What are the primary and secondary air pollutants? Give example.

## **SEMESTER-IV**

### **Course-IV**

#### **Dyes, Drugs, Pharmaceuticals, Leather chemistry, Paperindustry and Industrial waste management**

**60hrs (4 hours/week)**

#### **Course Outcomes**

At the end of the course student will be able to

- CO1 Describe the classification of dyes.
- CO2 Write down the industrial preparation of Common dyes.
- CO3 Describe the manufacture of leather.
- CO4 Write down the manufacture of pulp.
- CO5 Demonstrate the preparation of paper.
- CO6 Gain knowledge about the synthesis of important drugs.
- CO7 Demonstrate the steps involved in waste management.
- CO8 Describe the different water purification methods.

#### **Unit-1**

**12 hours**

##### **Dyes**

Introduction, Classification with special reference to textile and edible dyes and fabric brighteners. Industrial preparation and uses of methyl orange, malachite green, indigo, bismark brown, alizarin.

#### **Unit-2**

**08 hours**

**Leather Chemistry-** Introduction, Manufacture of Leather and Preparation of hides for tanning, vegetable, chrome and oil tanning.

#### **Unit-3**

##### **Paper Industry**

**10 hours**

**Pulp and Paper-** Introduction, Manufacture of pulp, sulphate or kraft pulp, soda pulp, sulphite pulp, rag pulp, beating, refining, filling, sizing and coloring of pulp, manufacture of paper.

**Unit-4**  
**Drugs and Pharmaceuticals**

**15 hours**

Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulfamethoxazole and Sulphacetamide); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antileprosy (Dapsone), HIV/AIDS related drug (AZT- Zidovudine).

**Unit-5**  
**Industrial Waste Management**

**15 hours**

Waste water treatment - primary, secondary & tertiary treatment

Solid Waste Management Pyramid – Key Technologies for SWM (collection, handling, transformation, landfills, incinerators, composting)

Water treatment and purification (reverse osmosis, electro dialysis, ion exchange)

**Co-curricular activities and Assessment Methods**

1. **Assessment of Learning:** Summative assessment- Conduct of semester end exams.
2. **Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
3. **Assessment as learning:** Self-assessment-assignments, slip tests etc.,
4. **Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc., .**



## Laboratory Course –IV

50 Marks

### Practical Paper- IV (at the end of semester IV) 30 hours (2 hours/week)

#### Course Outcomes

At the end of the course student will be able to

CO1 Prepare Methyl orange

CO2 Synthesize important compounds

1. Preparation of Methyl Orange.
2. Synthesis of common industrial compounds involving two step reactions, e.g. 4- bromo aniline, 3-nitroaniline, sulphanilamide, 4-amino benzoic acid, 4-nitro benzoic acid, nitrohalobenzenes, oil of winter green)(**ANY THREE**)

#### Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
3. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
4. *Practicals and Calculation in Engineering Chemistry* – S.S. Dara
5. S.P. Mahajan: *Pollution control in process industries*, Tata McGraw-Hill publishing company limited, New Delhi.
6. G.L. Patrick: *Introduction to Medicinal Chemistry*, Oxford University Press, UK.
7. Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi.
8. William O. Foye, Thomas L., Lemke, David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt Ltd. New Delhi.
9. Jayashree Ghosh: *Text Book of Pharmaceutical Chemistry*, 2nd edition, S.Chand & Company, New Delhi

**MODEL PAPER**  
**SECOND YEAR B.Sc., DEGREE EXAMINATION**  
**SEMESTER-IV**  
**INDUSTRIAL CHEMISTRY Course-IV: Dyes, Drugs, Pharmaceuticals,**  
**Leather chemistry, Paper industry and Industrial waste management**

Time: 3 hours

Maximum Marks: 75

**PART- A**

5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Write the preparation and uses of alizarin.
2. What are fabric brighteners? Explain in brief.
3. Explain in brief preparation of hide for tanning.
4. What is rag pulp. Explain briefly.
5. Write the structure and uses of Acyclovir.
6. Write a note on Zidovudine.
7. Define the term 'Incineration'. Explain in brief.
8. Explain in brief how ion exchange method is used for the purification of water.

**PART- B**

5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Describe the classification of textile dyes.  
(or)  
(b) Explain the industrial preparation and uses of methyl orange and malachite green.
10. (a) Describe in detail important steps involved in the manufacture of Leather.  
(or)  
(b) Describe the vegetable tanning process in detail.
11. (a) Explain the Kraft process for the production of pulp.  
(or)  
(b) Explain with a neat diagram several stages involved in the paper manufacturing

process.

12. (a) Write the synthesis of paracetamol and aspirin.

(or)

(b) Write the synthesis of Phenobarbital and Dapsone.

13. (a) Explain in detail the different stages involved in the waste water treatment.

(or)

(b) What is Reverse osmosis? Explain how it is used for the purification of water.

## **SEMESTER-V**

### **Course-V**

#### **Polymers and Instrumental methods of analysis**

**60hrs (4 hours/week)**

#### **Course Outcomes**

At the end of the course student will be able to

- CO1 Describe the classification of polymers.
- CO2 Write down the manufacture of commonly used polymers.
- CO3 Describe about Specialty polymers.
- CO4 Write down about boron containing, phosphorus containing and, silicon containing polymers.
- CO5 Describe about important electro analytical techniques.
- CO6 Describe the thermo analytical techniques.
- CO7 Write about the principle and applications of flame photometry.
- CO8 Write about the principle and applications of atomic absorption spectroscopy.

#### **Unit-1**

**15 hours**

##### **Organic Polymers-1**

Basic definitions, degree of polymerization, classification of polymers- Natural and Synthetic polymers, Organic and Inorganic polymers, Thermoplastic and Thermosetting polymers, Plastics, Elastomers, Fibers and Resins, Linear, Branched and Cross Linked polymers, Addition polymers and Condensation Polymers, mechanism of polymerization-Free radical, ionic and Zeigler-Natta polymerization. Industrial manufacturing and applications of following polymers, Polystyrene, Polyacrylonitrile, Polymethacrylate, Polymethyl- methacrylate, Polyethene, poly vinyl chloride, PTFE, Polyesters, Polyurethanes, Nylon (6 and 66).

#### **Unit-2**

**15 hours**

##### **Organic Polymers-2**

Specialty Polymers (Electro-luminescent, Biopolymers, Conducting polymers), Rubbers (synthetic and natural) and their processing, Elastomers, Cellulosics, Natural and Synthetic

fibers. Comparison of natural and synthetic polymers. Polymer Processing: Moulding, compounding, blending. Polymer designing: packaging, certification and process evaluation.

**Unit-3**

**8 hours**

**Inorganic Polymers:** Classification, preparation, properties and uses of boron containing polymers, phosphorus containing polymers, silicon containing polymers- Silicones (fluid, elastomers and resins) and Sulphur containing polymers (SN)x.

**Unit-4**

**16 hours**

**Instrumental methods of analysis**

**Electro analytical techniques-** Potentiometry, voltammetry, polarography and Colorimetry- principle, instrumentation and applications.

**Thermo analytical techniques-** Thermal gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) – principle and applications.

**Unit-5**

**06 hours**

**Instrumental methods of analysis**

**Atomic spectroscopy**

**Atomic Spectroscopy-** Flame photometry, Atomic absorption spectroscopy- Principles and their applications.

**Co-curricular activities and Assessment Methods**

- 1. Assessment of Learning:** Summative assessment- Conduct of semester end exams.
- 2. Assessment for Learning:** Formative assessment- Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
- 3. Assessment as learning:** Self-assessment- assignments, slip tests etc.,
- 4. Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc., .**

## Laboratory Course –V

50 Marks

### Practical Paper- V (at the end of semester V) 30 hours (2 hours/week)

#### Course Outcomes

At the end of the course student will be able to

CO1 Carry out the extraction of natural coloring and flavoring agents

CO2 Prepare Nylon 6,6

CO3 Determine  $\text{Na}^+$  and  $\text{K}^+$  using Flame Photometry.

CO4 Verify Beer Lambert's by using spectrophotometry

1. Extraction of natural coloring and flavoring agents from flowers and fruits (extraction of any three coloring and flavoring agents).
2. Preparation of nylon 6,6.
3. Determination of concentration of  $\text{Na}^+$  and  $\text{K}^+$  using Flame Photometry.
4. Verification of Beer Lambert's by using spectrophotometry.

#### Reference Books

1. K.J. Saunders: *Organic Polymer Chemistry*, Chapman & Hall, London.
2. P.J. Flory: *Principles of Polymer Chemistry*, Cornell University Press, NY.
3. G. Odian: *Principles of Polymerization*, John Wiley & Sons Inc, NY.
4. James E. Mark, Harry Allcock, Robert West, *Inorganic Polymers*, Prentice Hall Englewood.
5. Polymer science V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, Halsted Press (John Wiley & Sons), New York, 1986.
6. H.H. Willard, L.L. Merritt, J.A. Dean, F. A. Settle: *Instrumental Methods of Chemical Analysis*, Wadsworth Publishing Company, California.
7. G. D. Christian: *Analytical Chemistry*, John Wiley, NY.
8. S.M. Khopkar: *Basic Concepts of Analytical Chemistry*, Wiley Eastern Ltd, New Delhi.
9. D.A. Skoog, D.M. West, F.J. Holler: *Fundamentals of Analytical Chemistry*, Cengage Learning.

**MODEL PAPER**  
**SECOND YEAR B.Sc., DEGREE EXAMINATION**  
**SEMESTER-IV**

**INDUSTRIAL CHEMISTRY Course-V: Polymers and Instrumental methods of analysis**

Time: 3 hours

Maximum Marks: 75

**PART- A**

5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Describe in brief classification of polymers.
2. Write the preparation and properties of PVC.
3. Explain in brief the Zeigler-Natta polymerisation.
4. What is PTFE. Write the preparation and properties of PTFE.
5. Write a note conducting polymers.
6. Explain in brief about the preparation and properties of Sulphur containing polymers.
7. Write the principle and applications of Polarography.
8. What is DSC? Write its applications.

**PART- B**

5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Explain the preparation and properties of i) polystyrene and ii) Nylon 6,6.  
(or)  
(b) What is free radical polymerization? Explain in detail the mechanism.
10. (a) Describe about natural and synthetic rubbers .  
(or)  
(b) Write a note on i) Cellulosics and ii) Biopolymers
11. (a) Explain the preparation, properties and applications of Boron containing polymers,  
(or)  
(b) Explain the preparation, properties and applications of silicones.
12. (a) Explain the principle, instrumentation and applications of potentiometry.  
(or)  
(b) Describe the principle and applications of Thermal gravimetric analysis (TGA).

13. (a) Explain the principle and applications of Flame photometry.

(or)

(b) Explain the principle and applications of Atomic absorption spectroscopy