Swami Ramanand Teerth Marathwada University, Nanded

B. O. S. In Chemistry

B. Sc. Second Year (Industrial Chemistry)
Revised Syllabus

In force from June - 2009

B. Sc. Second Year
Industrial Chemistry

Paper	Course No.	Course Name	Hours	Marks
IV	CHIC-201	Unit Operations-II	80	100
V	CHIC-202	Chemical Reaction Engineering	80	100
VI	CHIC-203	Laboratory Course	120	100
VII	CHIC-204	Laboratory Course	120	100

B. Sc. Second Year (Theory) Course Structure
Paper-IV, Unit Operations-II (CHIC-201)

Time: 3 Hrs. **Marks: 100**

Unit	Topic	Title	Periods	Marks
I	1.1	Overview of Mass Transfer Operation	04	
	1.2	Distillition	10	
	1.3	Liquid Extraction	06	
II	2.1	Gas Absorption	10	
	2.2	Crystalization	10	
III	3.1	Draying of Solids	10	
	3.2	Evaporation	10	
IV	4.1	Size Reduction	10	
	4.2	Metallurgy	10	
		Grand Total	**80**	**100**

B. Sc. Second Year (Theory) Course Structure
Paper-V, Chemical Reaction Engineering (CHIC-202)

Time: 3 Hrs. **Marks: 100**

Unit	Topic	Title	Periods	Marks
I	1.1	Introduction and notation in Chemical Reaction Engineering	02	
	1.2	Overview Chemical Reaction Engineering	05	
	1.3	Kinetics Of Homogeneous Reaction	13	
II	2.1	Interpitation of Batch Reactor	10	
	2.2	Introduction to Reactor Design	10	
III	3.1	Ideal Reactors for single Reactions	10	
	3.2	Design of single reactions	08	
	3.3	Design of Parellel Reaction	02	
IV	4.1	Reaction Catalyzed by Solids	06	
	4.2	Solid Catalized Reactions	06	
	4.3	Biochmeical Reaction System	08	
		Grand Total	**80**	**100**

Note:

1. Question number one should be on Unit-I syllabus.
2. Question number two should be on Unit-II syllabus.
3. Question number three should be on Unit-III syllabus.
4. Question number four should be on Unit-IV syllabus.
5. Question number five should be on all units syllabus.
6. Multiple choice Questions should be from each topics to be covered.
7. ± 3 marks adjustment in given weightage should be allowed.

B. Sc. First Year
Industrial Chemistry
Paper – IV, Unit operations-II (CHIC-201)

Marks: 100 **Periods: 80**

Unit - I

1.1 Overview of Mass Transfer Operations: 04P

General Overview – Introduction to Mass Transfer operations, Benefits, General Principles of Mass Transfer, Importance & Classification of Mass Transfer Operations.

1.2 Distillation: 10P

Introduction, Flash Distillation, Simple Distillation, Steam Distillation, Rectification, Material Balances in Plate Columns, Number of Ideal Plates, McCabe Thiele Method, constant molal overflow, Reflux Ratio, Condenser and Top Plate, Bottom Plate and Reboiler, Feed Plate, Minimum Reflux, Optimum Reflux Ratio, Plate Efficiency, Types, Relations, Factors influencing plate efficiency, Rectification in packed towers, Batch Distillation.

1.3 Liquid Extraction: 06P

Terminology, Introduction to liquid-liquid extraction, Applications of Liquid-Liquid Extraction, Principles of liquid-liquid equillibria, Triangular diagrams, Types of extraction system, I & II, Temperature effects on systems types, Solvent selection, Commercial extraction system, Typical extraction system, Extraction calculations-Single Stage Operations, Multi Stage Cross Current Operation, Continuous multistage counter current operations.

Unit – II

2.1 Gas Absorption: 08P

Introduction, Design of Packed Towers, Contact between Liquid & Gas, Pressure drop & limiting flow rates, Principles of absorption material balances, Limiting gas-liquid ratio, Temperature variations in packed towers, Rate of absorption, Calculation of tower height, Number of Transfer units.

2.2 Crystallization 12P

Importance of Crystal Size, Crystal Geography, Crystallographic systems, Invariant Crystals, Principles of Crystallization, Purity of Product, Equillibria & its yields, Enthalpy Balances, Super Saturation, Units of Super Saturation, Temperature differential as a potential, Nucleation-Origins of Crystals in crystallizers, Primary nucleation, Homogeneous nucleation, Equilibrium, Kelvin Equation, Rate of nucleation, Heterogeneous nucleation, Secondary nucleation, Contact nucleation, Crystal Growth-Individual & overall Growth Coefficients, Growth Rate, Mass Transfer Coefficient, Surface Growth Coefficient, ΔL law of crystal growth, Crystallization Equipment-variations in crystallizers, Vacuum Crystallizers, Draft Tube Baffle Crystallizer, Yield of Vacuum Crystallizer.

Unit – III

3.1 Drying of Solids: 10P

Introduction, Classification of Dryers, Solid handling in dryers, Principles of Drying-Temperature Pattern in dryers, Heat Transfer in dryers, Heat duty, Heat Transfer Coefficient, Heat Transfer Units, Mass Transfer in Dryers, Phase Equillibra-equillibrium moisture and free moisture, Bound & unbound water, Cross circulating drying-constant drying conditions, Rate of drying, Constant rate period, Critical Moisture Content & Falling Rate Period, Calculation of Drying Time under constant drying conditions, Drying Equipments-Dryers for Solids & Pastes, Dryers for Solutions & Slurries.

3.2 Evaporation: 10P

Introduction, Liquid Characteristics, Types of Evaporators, Performance of Tubular Evaporators, Evaporator Capacity, Boiling Point Elevation and Duhring Rule, Effect of liquid head & friction on temperature drop, Heat Transfer Coefficient, Overall Coefficient, Evaporator economy, Enthalpy balance for single effect evaporator, Enthalpy balance with negligible heat of dilution, Single effect calculations, Multiple effect evaporators, Methods of feeding, Capacity and economy of multiple effect evaporator, Effect of liquid head and boiling point elevation.

Unit – IV

4.1 Size Reduction: 08P

Introduction, Principles of Comminution, Criteria for comminution, Characteristics of comminuted products, Energy & Power requirements in comminution, Crushing efficiency, Empirical relationship-Rittingers & Kicks Law, Bond Crushing Law & Work Index, Size reduction equipments.

4.2 Metallurgy: 12P

Introduction, Occurrence of Metals, Ore dressing, Ion Exchange method in metallurgy, Solvent Extraction Method in Metallurgy.

Mettallurgy of Iron: Occurrence Manfacturing of Cost Iron, Vertities of Cost Iron, Physical and Chemical Properties, uses.

Mettallurgy of Copper: Occurrence, Extraction of Copper, Properties, Alloys of Copper, Uses.

Reference Books:

1. Unit Operations of Chemical Engineering – W.L.McCabe, J.C. Smith, Pter Harriott
2. Mass Transfer Operations- Robbert E. Treybal
3. Chemical Engineering Vol.2 – J.M.Coulson & J.F.Richardson
4. Principles of Mass Transfer Operations- Kiran D. Patil
   (Nirali Prakashan, Pune)
5. Unit Operations-II – K.A.Gavhane
   (Nirali Prakashan, Pune)
6. Industrial Chemistry – B.K. Sharma
   (Goel Publishing House, Meerut)

B. Sc. First Year
Industrial Chemistry
Paper – V, Chemical Reaction Engineering (CHIC-201)
Marks: 100 **Periods: 80**

Unit – I

1.1 Introduction & Notation in Chemical Reaction Engineering: 02P

1.2 Ovierview of Chemical Reaction Engineering: 05P

Typical Chemical Process, Classification of reactions, Variable Affecting the Rate of Reaction, Definition of Reaction Rate.

1.3 Kinetics of Homogeneous Reactions: 13P

The rate equation, Concentration-Dependent Term of a rate equation, Single & multiple Reactions, Elementary & Non elementary reactions, Molecularity & Order of Reaction, Rate Constant(K), Representation of an Elementary Reaction, Representation of Non elementary Reaction, Kinetic Models for Non elementary Reactions-free radicals, ions & polar substances, Molecules, Transition Complex, Non Chain Reactions, Chain Reactions-Free radicals, Chain reaction mechanism, Molecular intermediates, non chain mechanism, Transition Complex , non chain mechanism. Temperature-Dependent Term of a Rate Equation-Temperature Dependency from Arrhenius Law, Comparison of Theories with Arrhenius law, Activation Energy and Temperature Dependency, (Example 2.3).

Unit – II

2.1 Interpretation of Batch Reactor Data: 16P

Introduction of Batch Reactor, Constant-Volume Batch Reactor, Analysis of Total Pressure data obtained in a Constant-Volume System, Integral Method of Analysis of Data, Irreversible Unimolecular-Type First Order Reactions, Irreversible Bimolecular-Type Second Order Reactions, Zero Order Reactions, Overall Order of Irreversible Reactions from the Half-Life $t_{1/2}$, Irreversible reactions in Parallel, Homogeneous Catalyzed Reactions, Autocatalytic Reactions, Irreversible Reactions in Series, First Order Reversible Reactions, Second Order Reversible Reactions, Reactions of Shifting Order, Differential Method of Analysis of Data, Varying-Volume Batch Reactor, Differential Method of Analysis, Integral Method of Analysis, Zero Order Reactions, First Order Reaction, Second Order Reactions, The Search for a Rate Equation.

2.2 Introduction to Reactor Design: 04P

Broad Classification of Reactor Types, Material balance for an element of Volume of the reactor, Energy balance for an element of Volume.

Unit – III

3.1 Ideal Reactors for a Single Reaction: 06P

Three types of Ideal Reactors, Ideal Batch Reactor, Space Time & Space Velocity, Steady State Mixed Flow Reactor, (Example 5.1, Example 5.3), Steady State Plug Flow Reactor, (Example 5.5), Holding Time & Space Time for flow reactors.

3.2 Design for Single Reactions: 12P

Size Comparison of Single Reactors, Batch Reactor, Mixed versus Plug Flow Reactors, First & Second Order Reactions, Multiple-Reactor Systems-Plug flow reactors in series and or in parallel, (Example 6.1), Equal size Mixed Flow Reactors in Series, First Order Reaction, Mixed Flow Reactors of Different sizes in Series, finding the conversion in a given system, Determining the Best System for a given conversion, Maximization of Rectangles, Reactors of types in series, Recycle Reactor & its performance equation.

3.3 Design for Parallel Reactions: 02P

Introduction to Multiple Reactions-Qualitative Discussions about Product Distribution.

Unit – IV

4.1 Reactions Catalyzed by Solids: 06P

Heterogeneous Reactions-The burning of a Carbon Particle in Air, Overall Rate for Linear Process, Overall Rate for Nonlinear Process, Contacting Patterns for Two-Phase Systems.

4.2 Solid Catalyzed Reactions: 06P

Representation of the action of a Catalyst, The rate Equation for Surface Kinetics, Pore Diffusion Resistance Combined with Surface Kinetics.

4.3 Biochemical Reactions Systems: 08P

Enzyme Fermentation, Batch or Plug Flow Fermentor, Mixed Flow Fermontor, Inhibition by a Foreign Substance-Competitive and Noncompetitive Inhibition-Kinetics of competitive Inhibition , Kinetics of NonCompetitive Inhibition.

Reference Books:

1. Chemical Reaction Engineering - Octave Levenspiel (Wiley India Pvt. Ltd. Third Edn.)
2. Chemical Reaction Engineering - K. A. Gavhane (Nirali Prakashan, Pune)
3. Principles of Reaction Engineering – S. D. Dawande (Central Techno Publication)

B. Sc. First Year
Paper-VI, Laboratory Course (CHIC-203)

Marks: 100 **Periods: 120**

1. To perform an expt. on **Simple Distillation** using binary mixture (Methanol + Water or Ethanol+Water) & Verify the Raleigh's Equation and Calculate the Material Balance for Simple distillation.
2. To perform a expt. on Steam **Distillation** using Terpentine and Calculate Material Balance for Steam Distillation.
3. To perform an experiment on **Distillation with total reflux** using Binary mixture (Methanol + Water or Ethanol+Water) and Calculate number of plates for fractionating column.
4. To study the experiment on Liquid-Liquid Extraction by using **Mixer Settler** System & Calculate Percentage of Extraction.
5. To study the Liquid-Liquid Equillibria for three component system (**Glacial Acetic Acid +Chloroform+ Distilled Water**) and Calculate the Percentage composition of each component at heterogeneous mixture
6. To Study the distribution of Iodine between Water and CCl_4
7. To study the **Rate of Drying of solid** substances (saw dust or Card Board)
8. To study the **Rate of Drying of Liquid** substances.
9. To Crystallise the given sample of Phthalic acid from hot water using fluted paper and stemless funnel.
10. To Crystallise the given sample of Benzoic acid from hot water using fluted paper and stemless funnel.
11. To purify the given sample of naphthalene or camphor by simple sublimation method.
12. To purify the given sample of Succunic acid or phthalic acid by vacuum sublimation method.
13. Determine the rate of evaporation of given liquid Sample.
14. Istimation of Maganese in Pyrolusite ore
15. Estimation of Zink from Zink Blend ore
16. Estimation of Antimony in type metal
17. Determination of Copper in brass
18. Determination of percetage of Purity of Aluminium Metal
19. Determination of Nickel in Stainless Steel.
20. Prepration of Orange II dye
21. Prepration of Congo red dye

Note: 1. 20 % weightage be given to the viva-voce in the practical examination.
2. To Arrange Industrial visit for giving demo experiments on Drying, Mechanical Seperation, Size Reduction and various unit operations carried out in industry.

Reference Books:

1 Unit Operations-II - K.A.Gavhane
2. Systematic Experimental Physical Chemistry – S.W.Rajbhoj & T.K.Chondhekar
3. Practical Chemistry – S. Umar, J. Sardar & A. Muley
4. University Practical Chemistry, Vishal Publishing Co.Jalandhar-P.C.Kamboj

B. Sc. First Year
Paper-VII, Laboratory Course (CHIC-204)

Marks: 100 **Periods: 120**

1. To Study the Performance of **Batch Reactor :** To study the Saponification of Ethyl acetate with NaOH in order to determine Order of reaction (n) & Rate constant (K) using Batch reactor.
2. To Study the Performance of **Constant Stirred Tank Reactor** by using Ethyl acetate & NaOH.
3. To Study the Performance of **Plug Flow Reactor :** To study the Performance of plug flow reactor used and to calculate thereotical & practical conversion for a second order reaction between Ethyl acetate & NaOH.
4. To Study the Performance equation of **Coil Tube Reactor** : To study the Performance of plug flow reactor used and to calculate thereotical & practical conversion for a second order reaction between Ethyl acetate & NaOH.
5. To Study the **First Order Reaction**: Hydrolysis of an Ester (Methyl Acetate in presence of HCL).
6. To Study the **Zero Order Reaction**: Investigate the kinetics of Iodination of Acetone.
7. To Study the **Autocatalytic reaction**: Reaction between Potassium Permangnate & Oxalic acid.
8. To Study the Rate of reacation (r_A) between Ethyl bromo acetate & Sodium thiosulphate kinetically using **Batch Reactor.**
9. To determine the Order of reaction (n) of given reaction Kinetics by using **Substitution method, Fractional change method and Differential method.**
10. To determine the Rate Constant (K) of the reaction between Potassium Persulphate & Potassium Iodide having equal concentration of reacting species (a=b) by using **Mixed Reactor.**
11. To determine the Rate Constant (K) of the reaction between Potassium Persulphate & Potassium Iodide having un equal concentration of reacting species (a≠b) by using **Mixed Reactor.**
12. To determine rate constant (K) of the reaction between Bromic acid and Hydroiodic acid having equal concentration of reacting species (a=b) using **Batch reactor**.
13. To determine the **Energy of Activation (E_a)** of hydrolysis of Ethyl acetate in prewence of NaOH.
14. To determine the **Energy of Activation (E_a)** of the reaction pbtween Potassium Persulphate & Potassium Iodide.
15. Fermantation production of Industrial important enzymes (Amylazes,Cellulase etc.)

Note: 20 % weightage be given to the viva-voce in the practical examination.

Reference Books:

1. Chemical Reaction Engineering - K.A.Gavhane
2. Systematic Experimental Physical Chemistry – S.W.Rajbhoj & T.K.Chondhekar
3. University Practical Chemistry, Vishal Publishing Co.Jalandhar-P.C.Kamboj

Question Paper Pattern

B.Sc. (Second Year) Examination
Industrial Chemistry
Paper IVth
Unit Operation – II

Time : 3 Hours **Marks : 100**

N.B. i) Attempt all questions
ii) All Question carry equal Marks
iii) Draw diagram wherever necessary
iv) Scientific Calculator and log table is allowed

Q. No. I		Solve Any One	20 Marks
	a)		
	b)		
Q. No. II		Solve Any One	20 Marks
	a)		
	b)		
Q. No. III		Solve Any Two	20 Marks
	a)		
	b)		
	c)		
Q. No. IV		Solve Any Two	20 Marks
	a)		
	b)		
	c)		
Q. No. V		Solve Any Four	20 Marks
	a)		
	b)		
	c)		
	d)		
	e)		
	f)		

Question Paper Pattern

B.Sc. (Second Year) Examination
Industrial Chemistry
Paper Vth
Chemical Reaction Engineering

Time : 3 Hours **Marks : 100**

N.B. i) Attempt all questions
ii) All Question carry equal Marks
iii) Draw diagram wherever necessary
iv) Scientific Calculator and log table is allowed

Q. No. I		Solve Any One	20 Marks
	a)		
	b)		
Q. No. II		Solve Any One	20 Marks
	a)		
	b)		
Q. No. III		Solve Any Two	20 Marks
	a)		
	b)		
	c)		
Q. No. IV		Solve Any Two	20 Marks
	a)		
	b)		
	c)		
Q. No. V		Solve Any Four	20 Marks
	a)		
	b)		
	c)		
	d)		
	e)		
	f)		