

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

## M.Sc. Part-I

### Industrial Chemistry

#### Paper-I

Max. Marks: 100 (External-70 + Internal-30) To come in force from June-2004

### Unit Operations, Unit Process and Industrial Stoichiometry

Total Period/Hours : 120

#### UNIT-I : (20 hours)

Transport phenomena, Dimensional Analysis, Boundary layer concept, Roughness of pipe surface. Calculating of pressure drop, Friction losses in pipe and fittings. Flow in open channels, Centrifugal pump operating characteristics and efficiency.

#### UNIT-II : (20 hours)

Heat conduction through spheres. Heat transfer with phase change, Heat transfer equipments with special emphasis on design of heat exchangers and jacketed vessels, Compact exchangers (flat, spiral), extended surfaces. Mass and Energy balance – complex material balance, calculations with and without chemical reactions, recycle, bypass and purge, Energy balance for batch and continuous **process**.

#### UNIT-III (20 hours)

**Mass transfer operation** : Fick's law of diffusion, Construction and working of distillation **columns (Sieve plate bubble cap and packed towers)**, Plate efficiency. Rate of drying curve and calculations for driers. Leaching and liquid-liquid extraction, theory and calculations of number of stages for extraction.

#### UNIT-IV : (20 hours)

Flow sheet preparation and Elements of process, Flow diagram **symbols**, abbreviations and rules for flow sheet preparation of following unit process.

#### Unit Process:

(1) Sulphonation, (2) Nitration, and (3) Amination.

#### UNIT-V : (20 hours)

Flow sheet preparation and Elements of process, Flow diagram symbols, abbreviations and rules for flow sheet preparation of following unit process:

#### Unit Process:

(1) Halogenation, (2) Alkylation, and (3) Oxidation.

**Unit-VI : Designing Greener Process:**

**(20 hours)**

**(a) Conventional Reactors:**

(1) Batch-Reactors, (2) Continuous Reactors.

**(b) Inherently Safer Design:**

(1) Minimization, (2) Simplification, (3) Substitution, (4) Moderation, (5) Limitation.

**(c) Process Intensification:**

(1) Some PI equipment.  
(2) Examples of Intensified Process.

**(d) In-Process Monitoring:**

(1) Near-infrared Spectroscopy.

**REFERENCES:**

- (1) Introduction to Chemical Engg., W. Badger, J. Bancharo, McGraw Hill Co.
- (2) Stoichiometry, H. T. Bhatt, S. M. Vora, Tata McGraw Hill Co.
- (3) Basic Principles and Calculations in Chem. Engg., D. Himel Blan, Prentice Hall.
- (4) Green Chemistry & Introductory Text by Mike Lancaster, Royal Society of Chemistry, Cambridge, UK.

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

## M.Sc. Part-I

### Industrial Chemistry Paper-II

Max. Marks: 100 (External-70 + Internal-30)

To come in force from June-2004

### Technology of Chemical Industries

Total Period/Hours : 120

**UNIT-I : Principles and Concepts of Green Chemistry : Introduction: (20 hours)**

**(1) Atom Economic Reactions:**

- (a) Rearrangement Reactions
- (b) Addition Reactions

**(2) Atom Un-economic Reactions:**

- (a) Substitution Reaction
- (b) Elimination Reaction
- (c) Wittig Reaction

**(3) Reducing Toxicity: (a)**

Measuring Toxicity

**UNIT-II : Synthesis Involving Basic Principles of Green Chemistry : Some Examples: (20 hours)**

Introduction

Synthesis of styrene.

Synthesis of Adipic Acid, Catechol and 3-dehydroshikimic Acid

Synthesis of Methyl Methacrylate

Synthesis of Urethane.

An Environmentally Benign Synthesis of Anomeric Amines.

Selective Alkylation of Active Methylene Group.

Free Radical Bromination.

Acetaldehyde.

Furfural from Biomass.

Synthesis of (S)-metolachlor, An Optically Active Herbicide.

Synthesis of Ibuprofen.

Synthesis of Paracetamol.

Green Synthesis of 3-Phenyl catechol

Synthesis of Epoxy Styrene

Synthesis of Nicotinic Acid.

**UNIT-III : Aqueous Phase Reactions:**

**(20 hours)**

Introduction  
Diels-Alder Reaction  
Claisen Rearrangement  
Wittig-Horner Reaction  
Michael Reaction  
Aldol Condensation  
Knoevenagel Reaction  
Pinacol Coupling  
Benzoin Condensation Claisen-  
Schmidt Condensation  
Heck Reaction  
Wurtz Reaction  
Oxidation  
Reduction  
Polymerization Reactions  
Photochemical Reactions  
Electrochemical Synthesis  
Miscellaneous Reactions in Aqueous Phase

**UNIT-IV : Catalysis and Green Chemistry**

**(20 hours)**

Introduction to Catalysis  
Heterogeneous Catalysts  
Homogeneous Catalysis (a)  
Greener Lewis Acids Phase  
Transfer Catalysis  
(a) Oxidation Using Hydrogen Peroxide  
Biocatalysis  
Photocatalysis

**UNIT-V : Emerging Greener Technologies & Alternative Energy Sources:**

**(20 hours)**

**(1) Photochemical Reactions:**

- (a) Advantages of and Challenges Faced by Photochemical Process.
- (b) Examples of Photochemical Reactions.

**(2) Chemistry Using Microwaves:**

- (a) Microwave Heating
- (b) Microwave-assisted Reactions

**(3) Sonochemistry:**

- (a) Sonochemistry and Green Chemistry

**(4) Electrochemical Synthesis:**

- (a) Examples of Electrochemistry Synthesis

**UNIT-VI :****(20 hours)****(A) Petroleum Industry:**

Refining processes – Manufacturing of Petrochemicals from C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> cuts and aromatics (Outline and Review).

**(B) Polymer Industry:**

Techniques of polymerization, Industrial manufacture and uses of polyolefines, Vinyl polyester, Polyesters, Polyacrylates and Elastomers.

**REFERENCES:**

- (1) Unit Process in Organic Synthesis, Groggins.
- (2) Chemistry and Technology of Basic Organic and Petrochemical, Synthesis, N. M. Labedev, Vol. I&II.
- (3) Reagents for Organic Synthesis, Fieser & Fieser.
- (4) Organic Chemistry, Finar.
- (5) Green Chemistry & Introduction Text by Mike Lancaster, Royal Society of Chemistry, Cambridge.
- (6) Charles M. Sturks and Charles Liotta, Phase Transfer Catalysts, Academic Press, N.Y.
- (7) C. J. Sih and J. P. Rosazza in Application of Biochemical Systems in Organic Chemistry, Wiley, New York, 1976.

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

## M.Sc. Part-I

### Industrial Chemistry Paper-III

Max. Marks: 100 (External-70 + Internal-30)

To come in force from June-2004

### Industrial Management–Safety-Quality Control and Environmental Protection

Total Period/Hours : 120

#### **UNIT-I : Basic Concepts of Management, Function of Management: (20 hours)**

Planning, Organising, Directing, Control, Decision-making, Budgeting, Inventory Management (IM) & Quality Control (QC), Meaning & Importance of Inventory management, Inventory models, Cost consideration, Economic order quantity model. Meaning and importance of QC, Steps to improve quality with reference to ISO & TQM.

#### **UNIT-II : Entrepreneurship and Project Management: (20 hours)**

Role of entrepreneur, How to start for SSI, Generation and screening of project ideas, Technical Analysis. Financial Analysis.

#### **UNIT-III : Marketing Analysis: (20 hours)**

Meaning of marketing, Concept of marketing mix, product planning process, product life cycle. Advertising and Sales promotion — meaning and importance. Export management — Concept key decision in Global Marketing, Problems in export, requisite for successful export. Classification of product, Network techniques — importance of CPM & PERT. Small scale industries in Gujarat zones and types of industry, Role of State & Central Government, Legislations, Minimum Wages Act. Taxation (Sales Tax, Excise etc.) Laws, Norms laid by GPCB for Pollution Control.

#### **UNIT-IV : Safety: (20 hours)**

Flammable material handling and fire fighting equipments, Control measures for toxic chemicals, Industrial Hygiene, Safety in laboratories and plant, Safety in the transportation and storage of chemical.

#### **UNIT-V : Waste : Production, Problems & Prevention : (20 hours)**

1. Introduction.
2. Some problems caused by waste.
3. Sources of waste from the Chemical Industry.
4. The cost of waste.
5. Waste Minimization Techniques:
  - The Team approach to waste minimization
  - Process design for waste minimization.
  - Minimizing waste from Existing Processes.

6. On-site Waste Treatment: - Physical Treatment - Chemical Treatment - Biotreatment Plants
7. Design for Degradation:
  - Degradation & Surfactants - DDT
  - Polymers
  - Some Rules for Degradation
8. Polymer Recycling:
  - Separation & Sorting
  - Incineration
  - Mechanical Recycling
  - Chemical Recycling to Monomers

**UNIT-VI : Measuring & Controlling Environmental Performance:**

**(20 hours)**

1. The Importance of Measurement:
  - Lactic Acid Production
  - Safer Gasoline
2. Introduction to Life Cycle Assessment.
3. Green Process Matrics
4. Environmental Management Systems:
  - ISO-14001
  - The European Eco-management and Audit Scheme
5. Eco-Labels
6. Legislation - Integrated Pollution Prevention & Control

**REFERENCES:**

- (1) Properties of Polymers, D. W. Krenvelen.
- (2) Physical Chemistry of Polymers, A. Tagore.
- (3) Technology & Applications of Resins, D. G. Soni. Polymer Science, Gowarikar.

Polymer Technology, L. C. Miles, J. H. Priston, Chemical Publishing Co.

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

## M.Sc. Part-I

### Industrial Chemistry Practices

In Force From June-2004

Marks: 200 [External-120 + Internal-60 + Viva- 20]

#### GROUP-A:

- (1) Separation and identification of components in a mixture containing three components (Candidate will prepare two derivatives. Each student should carry out 8 separations).
  
- (2) Preparation of the following organic compounds involving not more than two steps:
  - (i) Resacetophenone from resorcinol
  - (ii) m-nitroaniline from nitrobenzene
  - (iii) p-nitroaniline from acetanilide
  - (iv) p-bromoaniline from acetanilide
  - (v) (3-resorcylic acid from resorcinol
  - (vi) Benzimidazole from o-phenylene diamine
  - (vii) Acid Orange-II from sulphanilic acid
  - (viii) 4-methyl 7-hydroxy coumarin from resorcinol
  - (ix) Synthesis of polymers Polystyrene by suspension and emulsion polymerization, polymethylmethacrylate by suspension method, polyvinylacetate by solution polymerization and polysulfide by condensation polymerization .
  - (x) Synthesis of resins: Alkyd resins, phenol-formaldehyde, urea formaldehyde, malemine formaldehyde, epoxy-liquid and epoxy-solid, unsaturated polyester. Synthesis of selected monomers.
  
- (3) Organic Estimations:
  - (i) To determine the amount of carboxylic acid and amide in mixture of carboxylic acid and amide.
  - (ii) To determine the amount of ester and acid in a mixture of ester and acid.
  - (iii) Determination of molecular weight by Rast's method

- (iv) Estimation of  $\text{NO}_2$  group
- (v) Estimation of glucose
- (vi) Amine by bromination and acetylation

(4) Separation of organic compounds using paper chromatography and thin layer chromatography (TLC) techniques.

**GROUP-B:**

Spectrophotometer determination of copper, nitrite, iron, phosphate, silicate and manganese. Simultaneous determination of  $\text{KMnO}_4$  and  $\text{K}_2\text{C}_2\text{O}_7$  in mixture using spectrophotometer.

Inorganic Qualitative Analysis (IQA):

- (i) Lead + Calcium mixture.
- (ii) Chromium + Iron mixture.
- (iii) Indirect determination of Barium.
- (iv) Replacement Titration.

(5) Spot test detection of Rare Earth metal iron.

**GROUP-C:**

- (1) PH metry titration of phosphoric acid. Determination of  $K_{a1}$  and  $K_{a2}$ .
- (2) Phase diagram for Ternary system.
- (3) Partition coefficient of Cupra ammonium complex.
- (4) Determination of molecular weight of polymer using viscosity method.
- (5) Kinetic study for hydrolysis of sugar using optical rotation.
- (6) Determination of critical micelle concentration (CMC) of surfactant by surface tension method.
- (7) Characterization of polymers: Softening point, gel time, density, bulk factor,  $T_g$  by DSC and thermogravimetry by TGA. Molecular weight by viscometry, metry and end point analysis.
- (8) Chemical analysis of polymers: Free styrene in polystyrene, acetic acid content of cellulose acetate, epoxy equivalent polyester, free phenol in PF resin, free formaldehyde in UF and MF resins.