

Syllabus for B.Sc., Petroleum & Petrochemicals  
II B.Sc., **Semester - III**  
**Paper – III – Introduction to Chemical Engineering**

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- UNIT-1 : Unit operations and unit processes – Basic laws – Ideal Gas Law, Avogadro's Law Dalton's Law, Amagat's Law, Average Molecular weight of a Gas mixture, Density of a Gas mixture, Mole fraction, Mass fraction Gibbs phase rule Henry's Law, Classius – Clapeyron Equation, Cox Chart, Duhring's plot
- UNIT-2: General Principles Applied in studying Industry: - Useful Mathematical methods – Method of Least squares, Graphical integration and Graphical differentiation, Dimensional Analysis – The Rayleigh method, the Buckingham Method.
- Unit-3: Physico-Chemical calculations:-  
Energy Equivalent Mass (weight) solutions – solubility, Distribution coefficient, vapour pressure of solutions, osmosis, Faraday's Laws of Electrolysis – Hardness of water and its removal, Humidity and saturation. Material Balance – steps to be followed in material balance calculations – Energy balance – steps to be followed in energy balance calculations.
- Unit-4: Measuring Devices:-  
Density and specific gravity – Hydrostatic Balance, Pycnometer or specific gravity bottle, Hydrometer, Ostwald Viscometer, Say bolt Viscometer, Spectrophotometric Analysis, Temperature Measurements – Liquid in glass thermometers, thermocouples, optical pyrometers.
- Unit-5: Flow Meters and Chemical Reactors:-  
Flow meters: Orifice meter, Venturimeter, Pitot tube, Rota meter.  
Chemical Reactors : Classification of Chemical Reactors – Batch Reactor, Semi-batch reactor, Continuous Flow Reactors, Continuous Stirred Tank Reactor (CSTR) Tubular Reactor, Fixed – Bed Reactors, Fluidized Bed Reactors, Moving Bed Reactors.

**Suggested Reading:**

- 1) Introduction to Chemical Engineering by Salil K. Ghosal and others. Tata Mc. Graw-Hill Publishing Company.
- 2) Unit operations – I and II by K.A. Gavhane. Nirali Prakashan – Pune.

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II B.Sc.- Petroleum & Petrochemicals  
**MODEL QUESTION**  
**PAPER**  
Paper – III – Introduction to Chemical Engineering

Time: 2 ½ Hrs.

Max. Marks 60

**Section – I**

Answer any three questions from the following  
All questions carry equal marks.

3 x 16=48 Marks

1. a. What are unit operations? Write about the classification of unit operations based on the mode of energy transport.  
b. Explain about Gibb phase rule
2. a. Write in detail about method of Least squares.  
b. In case of flow of fluid through a long straight and circular pipe, the pressure drop / loss due to friction depends upon the following variables.
  - i. Diameter of pipe (D)
  - ii. Length of Pipe (L)
  - iii. Velocity of fluid (u)
  - iv. Density of fluid ( $\rho$ )
  - v. Viscosity of fluid ( $\mu$ )From dimensional analysis, obtain the relation between pressure drop ( $\Delta P$ ) and these variables.
3. a. What are the basic steps (Procedure) to be followed for material balance calculations?  
b. Explain about Hardness of water and its removal
4. a. With a neat diagram describe how the coefficient of Viscosity of a Polymer solution can be determined with Ostwald Viscometer.  
b. Explain the design and functioning of a Thermocouple.
5. a. Explain the design and working of a Pitot Tube.  
b. With a neat diagram explain the functioning of Fluidized Bed Reactor.

**Section II**

Write short Notes on any four of the following

4 x 3 = 12 Marks

6. Duhring's plot.
7. The Rayleigh method.
8. Distribution Coefficient.
9. Pycnometer.
10. CSTR.

Note to Paper Setter:-

In section I one essay question is to be set from each of the five units.

Similarly in Section II, one short answer question is to be set from each of the 5 units.

II B.Sc., - Petroleum & Petrochemicals  
Paper –III: SEMESTER - III  
**Introduction to Chemical Engineering**  
**QUESTION BANK**

**Essay Questions: 16 M**

**UNIT –I:**

1. a. Write in detail about Unit Operations  
b. State and explain Clausius claypeyron equation
2. a. Write in detail about Unit Processes.  
b. State and explain about Gibbs phase rule
3. a. State and explain (i). Ideal gas law and (ii). Henrys law  
b. Explain about (i). Cox chart (ii). Duhrings plot

**UNIT –II:**

1. a. Write in detail about method of Least squares  
b. Explain about Dimensional analysis
2. a. Write about the method of Graphical integration  
b. Explain about the method of Graphical differentiation.

**UNIT –III:**

1. a. Write about the steps to be followed during material balance calculations  
b. State and explain Faradays laws of electrolysis
2. a. Write about the steps to be followed during energy balance calculations  
b. Write about Hardness of water and its removal

**UNIT –IV:**

1. a. Explain about the determination of coefficient of viscosity by Ostwald Viscometer  
b. Explain about hydrostatic balance
2. a. Explain about the design and functioning of a thermocouple  
b. Explain about the measurement of temperature by liquid in glass thermometer
3. a. Write about the determination of Specific gravity of a liquid by Pyknometer  
b. Explain about the Spectrophotometric analysis with applications

### **UNIT –V:**

1. a. Explain briefly about Continuous flow reactors  
b. Write in detail about Batch reactor
2. a. Explain the design and working of a Pitot tube  
b. With a neat diagram explain the functioning of Fluidized Bed Reactor.
3. a. Write about Continuous stirred tank reactor (CSTR) and tubular reactor  
b. Explain in detail about Orifice meter
4. a. Write in detail about Rota meter  
b. Explain in detail about fixed bed reactors

### **Short answer questions: 03 M**

### **UNIT - I:**

1. State and explain Amagats law
2. State the Daltons law and Avogadro's law
3. Write about Average molecular weight of a gas mixture and Density of gas mixture
4. Explain about Mole fraction and mass fraction

### **UNIT - II:**

1. Write about Rayleigh method
2. Explain about Buckingham method
3. Write a note on graphical integration

### **UNIT - III:**

1. Write a short note on Distribution coefficients
2. Explain about Osmosis
3. Write about Humidity and saturation
4. Write about Vapour pressure of a solution

### **UNIT - IV:**

1. Write briefly about Optical pyrometers
2. Explain briefly about determination of viscosity by Saybolt viscometer
3. Write about the determination of Specific gravity by Hydrometer
4. Explain the terms Density and Specific gravity

**UNIT - V:**

1. Write a short note on classification of chemical reactors
2. Explain briefly about Semi batch reactor
3. Write about moving bed reactor

**IMPORTANT NOTE TO PAPER SETTER:**

In section - I, one essay question is to be set from each of the five units. Similarly  
in

Section - II, one short answer question is to be set from each of the five units.  
Questions should be given from QUESTION BANK.

II B.SC., Petroleum & Petrochemicals  
**PRACTICAL SYLLABUS**  
Semester - III

PRACTICAL - III (At the end of Third Semester)

- 1) Aniline point determination – Method A
- 2) Carbon Residue by Ramsbottom method.
- 3) Carbon Residue by Conradson method.
- 4) Saybolt Viscometer

SCHEME OF  
VALUATION

Max. Marks: 35

- |    |   |          |
|----|---|----------|
| 1) | Procedure to be written in the first 15 minutes | 10 Marks |
| 2) | Recording of data and reporting the value       | 15       |
|    | Marks upto 2% error                             |          |
|    | Error up to 5%                                  | 10 Marks |
|    | Error greater than 5%                           | 5 Marks  |
| 3) | Viva – Voice                                    | 5 Marks  |
| 4) | Record  | 5 Marks  |