#### Syllabus II B.Sc., - (Petroleum & Petrochemicals) Semester - IV

#### Paper - IV: Heat Transfer and Flow of Fluids

Unit – 1: <u>Heat Transfer</u>:

Conduction – Fourier's Law, conduction through plane wall and through resistances in series, Heat flow through thick walled cylinder, Heat flow through a sphere. Thermal Insulation

Radiation: Laws of Black – Body radiation, Kirchhoff's law, Stefan-Boltzmann law, Planck's law, concept of Black Body.

Unit – 2: <u>Heat Transfer</u> :

Convection : Natural and forced convection – Heat Transfer with change in Phase – Mechanism of Condensation Heat Transfer and Boiling Heat Transfer, Over all Heat Transfer coefficients, Logarithmic Mean Temperature difference.

Flow arrangements in Heat exchangers, Variation of Fluid Temperatures in Heat exchangers, Heat Transfer Equipment. Double pipe heat exchanger and shell and tube heat exchanger.

- Unit 3: <u>Evaporation</u>: Material and Enthalpy balances for single effect Evaporator – Types of Evaporators-Common methods of feeding multiple evaporation system – Multiple effect Evaporation, Vapour Recompression, capacity and economy of evaporator
- Unit 4: <u>Flow of fluids</u> I: Nature of Fluids – Hydrostatic pressure, Manometers – U-tube, Differential and inclined – Viscosity, Newton's Law of Viscosity Types of fluid motion, Mass balance, Equation of Continuity, Energy Balance Bernoulli's Equation, Reynolds's Experiment.

 Unit – 5: <u>Flow of fluids</u> - II: Friction losses in Laminar flow through a circular Tube, Hagen – Poiseuille Equation, Friction losses in turbulent flow – Fanning equation, Pressure drop in flow through porous media – Fluidization, Cavitation, Water Hammer.

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,

#### II B.Sc., Petroleum & Petrochemicals

#### **MODEL QUESTION PAPER**

Paper IV- Heat Transfer and Flow of Fluids

Time:  $2^{1}/_{2}$  Hrs.

Semester - IV

Max. Marks 60

### Section - I

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

3x6=48 Marks

- 1. a. State and explain Fourier's law of Heat conduction. Derive the steady State heat transfer equation through a flat wall of three layers which are in perfect thermal contact.
  - b. Derive the heat transfer equation for Heat flow through a sphere.
- a. Explain the mechanism of condensation heat transfer.b. Explain about the variation of fluid temperature in Heat Exchanges.
- **3.** a. What do you mean by Evaporation? Describe the Design and functioning of Forced circulation type Evaporator.
  - b. With a neat sketch, explain Thermal Vapour Recompression process.
- 4. a. What is Viscosity? How fluids are classified on the basis of Viscosity? Discuss in detail with examples
  - b. Derive Bernoulli's Equation
- a. Derive Hagen Poiseuille equation.b. Write briefly about pressure drop in flow through a porous media.

### <u>Section – II</u>

Write short notes on ANY FIVE of the following.

4x3=12 Marks

- 6. Write the laws of Radiation.
- 7. Write short notes on double pipe heat exchanger.
- 8. Multiple effects Evaporation.
- 9. Newton's law of viscosity
- 10. Water Hammer

Note to Proper setter:

In section I, one essay question is to be set from each of the 5 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 –IV: SEMESTER - IV Heat Transfer and Flow of Fluids\_ <u>QUESTION BANK</u>

#### Essay Questions: 16 M

### <u>UNIT –I:</u>

- a. Derive the steady state heat transfer equation through a plane wall
  b. Derive the steady state heat transfer equation through a flat wall of three layers which are I perfect thermal contact.
- 2. a. Derive the steady state heat transfer equation through a thick walled cylinder
  - b. Derive the steady state heat transfer equation through a sphere
- 3. a. State and explain Kirchhoff's lawb. Explain about the laws of Black body radiation

# <u>UNIT –II:</u>

- a. Explain the mechanism of condensation heat transfer.
  b. Derive the expression for overall heat transfer coefficient based on inside area
- 2. a. Explain about the variation of fluid temperature in Heat Exchanges.b. With a neat sketch describe about the design and functioning of shell and

heat exchanger

3. a. Explain in detail about heat transfer equipmentb. Write about the design and functioning of double pipe heat exchanger.

# <u>UNIT –III:</u>

tube

- 1. a. Write about the material and enthalpy balance calculations for single effect evaporator.
  - b. With a neat diagram explain he design and functioning of long tube vertical evaporator
- 2. a. With a neat diagram describe the Design and functioning of Forced

circulation type Evaporator.

- b. With a neat sketch, explain Thermal Vapour Recompression process.
- 3. a. With a neat diagrams explain Common methods of feeding multiple evaporation system
  - b. With neat sketches explain about multiple effect evaporation

### UNIT –IV:

1. a. What is Viscosity? How fluids are classified on the basis of Viscosity? Discuss

in detail with examples

- b. Derive the basic equation for obtaining the pressure at any height in hydrostatic equilibrium and apply it to an incompressible fluids.
- a. Explain about the design and working of U –tube manometer. Derive the expression used to calculate the pressure difference in the case of

a flowing fluid.

b. Based on the law of conservation of mass, derive the equation of continuity of

one dimensional flow.

a. Derive Bernoulli's Equation
 b. Explain in detail about Reynold's Experiment.

### <u>UNIT –V:</u>

Reynolds

1. a. Derive Hagen – Poiseuille equation for Friction losses in Laminar flow through

a circular Tube

- b. Write in detail about the pressure drop in flow through porous media
- 2. a. Derive Fanning equation for the Friction losses in turbulent flowb. Derive the expression for the relation between friction factor (f) and

number (N<sub>Re</sub>) in Laminar flow and turbulent flow.

# Short answer questions: 03 M

# <u>UNIT - I:</u>

- 1. Explain about Fourier's law of conduction
- 2. Write about thermal insulation
- 3. Explain the concept of black body
- 4. Write about Planck's law
- 5. Explain about Stefan Boltzmann's law

# <u>UNIT - II:</u>

- 1. Write about types of convections
- 2. Explain about Logarithmic mean temperature difference
- 3. Write a note on flow arrangements in heat exchangers
- 4. Write the mechanism of boiling heat transfer

# <u>UNIT - III:</u>

- 1. Write briefly about Capacity and economy of an evaporator
- 2. Write about the process of evaporation
- 3. Explain the types of evaporators

# UNIT - IV:

- 1. Write about Newton's law of viscosity
- 2. Explain briefly about Newtonian and non-Newtonian fluids.
- 3. Write about Reynolds number
- 4. Explain about hydrostatic pressure
- 5. Write about differential manometer

# <u>UNIT - V:</u>

- 1. Explain briefly about Water Hammer
- 2. Write about Fluidization
- 3. Write about Cavitation

# **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 - IV

#### PRACTICAL IV (At the end of Fourth Semester)

- 1) Determination of Viscosity Index.
- 2) Redwood Viscometer.
- **3**) Engler Viscometer.
- 4) Ostwald viscometer
- 5) Determination of Iodine Value.

### 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 Marks upto 2% error	15
	Error up to 5%	10 Marks
	Error greater than 5%	5 Marks
3)	Viva – Voice	5 Marks
4)	Record	5 Marks