

This question paper contains 3 printed pages]

**NA—253—2023**

**FACULTY OF SCIENCE**

**B.Sc. (Second Year) (Fourth Semester) EXAMINATION**

**NOVEMBER/DECEMBER, 2023**

**(New Course)**

**INDUSTRIAL CHEMISTRY**

**Paper—VIII**

**(Unit Operation—IV)**

**(Wednesday, 27-12-2023)**

**Time : 2.00 p.m. to 4.00 p.m.**

*Time—2 Hours*

*Maximum Marks—40*

*N.B. :— (i) All questions carry equal marks.*

*(ii) Use of scientific calculator and log table is allowed.*

1. Explain evaporation operation in detail and give the material and energy balances for single effect evaporator. 15

*Or*

Solve the problems : 8

(a) A solution containing 10% solids is to be concentrated to a level of 50% solids. Steam is available at pressure of 0.20 MPa. Saturation temperature 393 K (120°C). Feed rate to the evaporator is 30000 kg/h. The evaporator is working at reduced pressure such that boiling point is 323 K (50°C). The overall heat transfer coefficient is 2.9 kW/m<sup>2</sup>K. Estimate the steam economy and heat transfer surface for :

P.T.O.

- (i) Feed introduced at 293K (20°C)
- (ii) Feed introduced at 308 K (35°C).

**Data :** Specific heat of feed = 3.98 kJ/kg.K.

Latent heat of concentration of steam at 0.20 MPa = 2202 kJ/kg.

Latent heat of vaporisation of water at 323 K (i.e. at pressure in the vapor space = 2383 kJ/kg.

- (b) A single effect evaporator is fed with 5000 kg/h of solution containing 1% solute by weight. Feed temperature is 303 K (30°C) and is to be concentrated to a solution of 2% solute by weight. 7

The evaporation is at atmospheric pressure (101.325 KPa) and area of evaporator is 69 m<sup>2</sup>. Saturated steam is supplied at 143.3 KPa as a heating medium. Calculate the steam economy and the overall heat transfer coefficient.

**Data :** Enthalpy and feed at 303 K = 125.79 kJ/kg.

- 2. Explain size reduction operation and various law of size reductions and crushing efficiency with mathematical expression. 15

*Or*

- (a) Give the difference between crushing and grinding operation. 7
- (b) Explain Ball mill with neat labelled diagram. 8

Enthalpy of vapour at 101.325 KPa = 2676.1 kJ/kg

WT

( 3 )

NA—253—2023

Enthalpy of saturated steam at 143.3 KPa = 2691.5 kJ/kg

Saturation temperature of steam = 383 K (110°C)

Boiling point of saturation = 373 K

Enthalpy of product = 419.04 kJ/kg

Enthalpy of saturated water at 383K = 461.30 kJ/kg.

3. Write short notes on (any *two*) :

10

- (i) Short tube evaporator
- (ii) Black jaw crusher
- (iii) Tray dryer
- (iv) Spray dryer.

NA—253—2023

3