53 (FPT 403) TPEN

2018

TRANSFER PROCESS ENGINEERING

Paper : FPT 403

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions out of **seven.***

1. 5+6+2+4+3=20

(a) Write Fick's first law of diffusion.

(b) What is diffusive and convective mass transfer ?

(c) Write diffusivity range of solute in gas and liquid.

(d) How diffusivity of solute changes with pressure, temperature, molecular size and molecular weight ?

(e) What are SI units of Flux, diffusion coefficient, mass transfer coefficient?

2. 5+9+6=20

(a) Write Fourier's law of heat conduction.

(b) What is conductive, convective and radiative heat transfer process?

(c) Calculate heat loss per m^2 of surface area for an insulating wall made of 25·4 *mm* thick insulation where inside temperature is 352·7 *K* and outside temperature is 297·1 *K*. Thermal conductivity of insulation is 0·048 *W/mK*.

3. 6+8+6=20

(a) What is log mean temperature difference?

(b) Why it is relevant to heat exchanger? Discuss.

(c) Write Newton's law of viscosity and define all the terms.

4. Discuss briefly about the following unit operation : 5×4=20

Absorption

Adsorption

Distillation

Liquid-liquid extraction

Leaching.

5. Write about interphase mass transfer assuming two-film model and equilibrium at the interphase. Discuss with equilibrium plot to derive overall mass transfer coefficients. 20

6. It is desired to absorb 90% solute in a gas phase containing 1 *mol*% solute in a counter-current stage tower. The total inlet gas flow to the tower is 30 *kg mol/h*, total inlet pure liquid to be used to absorb the solute is 90 *kg mol* liquid/*h*. The process is isothermal at 300 *K* and pressure 101·3 *kPa*. The equilibrium relation for the solute in the gas-liquid is $Y_A = 2{\cdot}53X_A$. Determine the number of theoretical stages required for separation. 20

7. 10+10=20

(a) Discuss *any* mass transfer model.

(b) A molecule is being transported by diffusion through a fluid at steady state. At initial point 1, concentration of solute is $1{\cdot}37\times10^{-2}\,g/m^3$ and at final point 2, the concentration of solute is $0{\cdot}72\times10^{-2}\,g/m^3$. The distance between two points is $0{\cdot}4m$. Diffusion coefficient is $0{\cdot}013m^2/s$ and diffusion is through constant cross-sectional area.
Calculate molecular flux. Calculate concentration of solute at the middle point.
