53 (FPT 403) TPEN

2019

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. 8+6+6=20

(i) Write Newton's law of viscosity and discuss with diagram.

(ii) How viscosity of gas and liquid change with temperature and pressure and why ?

(iii) Write Fourier's Law of heat conduction.

Contd.

2. 10+6+4=20

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

(ii) How thermal conductivity varies for gas, liquid and solid ?

(iii) Write SI units for flux, diffusion coefficient, mass transfer coefficient, volumetric oxygen transfer coefficient.

3. 12+2+4+2=20

(i) Write Fick's 1st and 2nd law of diffusion, define all terms and conditions.

(ii) What is Flux ?

(iii) How diffusivity changes with pressure, temperature, molecular size and molecular weight ?

(iv) Mention diffusivity range of gas and liquid.

4. 10+10=20

(i) Discuss briefly about "interphase mass transfer" with diagram mentioning the required diagram.

(ii) Discuss *any* mass transfer modes.

5. 12+8=20

(i) A solute is being transported by diffusion through a fluid at steady state. At initial point *(1)* concentration of molecule is $1{\cdot}37 \times 10^{-2} g/m^3$ and at final point *(2)* is $0{\cdot}72 \times 10^{-2} g/m^3$. The distance between two points is 0·4*m*. Diffusivity is $0{\cdot}013 m^2/s$ and cross-sectional area is constant.

Calculate molecular flux.

Calculate concentration at the middle point.

(ii) Write convective mass transfer coefficient and discuss.

6. Discuss the following : ***(any four)*** 4×5=20

(a) Absorption

(b) Adsorption

(c) Distillation

(d) Liquid-liquid Extraction

(e) Leaching.

7. 10+10=20

(i) Define "stage" and "stage efficiency".

(ii) Discuss absorption of a solute in a counter-current multistage liquid-liquid extraction (contact) process.