A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 97902

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2024

Seventh Semester

Chemical Engineering

19UCH702 - TRANSPORT PHENOMENA

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Tooth paste is an example of CO1- R

   (a) Newtonian fluid (b) Dilatant (c) Bingham (d) Pseudo plastic

2. Power law model is also called as CO1- R

   (a) Bingham model (b) Oswald-de Waale model

   (c) Eyring model (d) The Ellis model

3. $DV\rho/\mu$ is called CO2- R

   (a) Grashoff number (b) pradntl number (c) Reynolds number (d) Nusselt Number

4. For laminar flow Reynolds number is CO2- R

   (a) $N_{Re} = 2100$ (b) $N_{Re} < 2100$ (c) $N_{Re} > 2100$ (d) $N_{Re} > 4000$

5. Sun is the finest example of CO3- R

   (a) Convection (b) heat flux

   (c) radiation (d) Fission.

6. The ratio of driving force and resistance is called CO3- R

   (a) Force (b) Flux (c) shear stress (d) shear rate

7. What is the unit of diffusion coefficient? CO4- R

   (a) m^2. (b) s (c) m^2 s. (d) m^2/s.

8. Diffusion of components between the phases at equilibrium is CO4- R

   (a) Zero (b) Infinity (c) Changes continuously (d) Diffusion never occurs

9. Consider the above problem, estimate the value of Reynolds numbered CO5- R

(a) 0.12 (b) 0.13 (c) 0.14 (d) 0.15

10. The fundamental law used for momentum transfer is CO5- R

(a) Fourier's law (b) Fick's law (c) Newtons's law (d) Erying model

PART – B (5 x 2= 10 Marks)

11. Define Viscosity. CO1- U

12. What is No slip condition? CO2- U

13. Define Conduction. CO3- U

14. Define Fick's law of diffusion CO4- U

15. State the Reynold's analogy. CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) Explain the theory of viscosity of liquids. CO1- U (16)

Or

(b) Compute the mean molecular velocity $\hat{U}$, cm sec^{-1}, and the mean free path λ of O_2 at 1 atm and 273.2^0 K. Assume d = 3 .0 A. what is the ratio of mean free path to the molecular diameter in this situation? CO1- E (16)

Data:

K= 1.38 X 10^{-16} erg/mol.K

N= 6.023 X 10^{23} l/gm mole

n = Flow behavior index= 2.68 x 10^{15}

17. (a) Derive Navier-Stokes equation by equation of motion. CO2- App (16)

Or

(b) Find the equation for an average velocity of an incompressible fluid flowing in an annular region in two co-axial circular cylinder. Assume that the flow is laminar. CO2 -App (16)

18. (a) Calculate the heat loss per m^2 of surface area for an insulating wall composed of 25.4 mm thick fibre insulating board, where the inside temperature is 352.7 K and the outside temperature is 297.1 K. the thermal conductivity of fibre is 0.0048 W/m.K. CO3- App (16)

Or

(b) A thick walled cylindrical tubing of hard rubber having an inside radius of 5mm and outside radius of 20 mm is being used as temporary cooling coil in a bath. Ice water is flowing rapidly inside, and the inside wall temperature is 274.9 K. The outside surface temperature is 297.1 K. A total of 14.65 W. heat must be removed from the bath by the cooling coil. How many m of tubing are needed? The thermal conductivity is 0.151W/m.K. CO3- App (16)

19. (a) The O_2 (a) is diffusing through CO(B) under standard conditions with CO non diffusing. The total pressure is 1 x 10^5 N/m^2 and temperature is 0^oc. The partial pressure of O_2 at two planes, 2.0 mm apart is 1300 and 6500 N/m2. The diffusivity of oxygen in CO is D_{AB} = $1.87x10^{-5}m^2$/sec. Calculate the rate of diffusion of O_2 in kmole/m^2.sec. CO4- App (16)

Or

(b) The solute HCl (A) is diffusing through a thin film of water (B) 2.0 mm thick at 283^0K. The concentration of HCl at point (1) at one boundary of the film is 12 wt. % HCl ($\rho 1$ = 1061 kg/m^3) and the other boundary at point (2) is 6 wt % HCl ($\rho 2$=1030 kg/m^3). The diffusion co. efficient of HCl in water is 2.5 x 10^{-9} m2/sec. Assuming steady state conditions prevail and the boundary is impermeable to water, calculate the flux of HCl in Kmole/m^2.sec. CO4- App (16)

20. (a) Arrive the equation $W'_A=WL_cA_o\sqrt{4D_{AB}}\ V_{max}/\pi L$ for forced convection in falling liquid film. CO5- App (16)

Or

(b) Explain in detail about diffusion in laminar falling film. CO5- U (16)