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

Question Paper Code: 57901

B.E./B.Tech. DEGREE EXAMINATION, NOV 2019

Seventh Semester

Chemical Engineering

15UCH701 - TRANSPORT PHENOMENA

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. At the interface between gas and liquid, shear stress for a Newtonian fluid is CO1- R
   (a) 0 (b) $\mu du/dy$ (c) Infinity (d) Finite and negative
2. Viscosity of gas depends on CO1- R
   (a) T (b) $T^{1/2}$ (c) T^2 (d) $T^{3/2}$
3. The fluid property, due to which, mercury does not wet the glass is CO2- R
   (a) Adhesion (b) Cohesion (c) viscosity (d) Surface tension
4. The velocity profile for turbulent flow through a closed conduit is CO2- R
   (a) Linear (b) Parabolic (c) Logarithmic (d) Hyperbolic
5. At constant temperature, the thermal conductivities of gases _____ with rise in pressure. CO3- R
   (a) Increase depends on pressure (b) Increase
   (c) Decrease (d) Remains same
6. Prandtl number for most of dry gases is about CO3- R
   (a) 150 (b) 0.72 (c) 70 (d) 0.001
7. Mass transfer rate between two fluid phases does not necessarily depend on the _____ of the two phases. CO4- R
   (a) Physical Properties (b) Chemical Properties
   (c) Interfacial Area (d) Degree of Turbulence

8. At 750°K and 1 atm, the approximate value of Schmidt number for air is CO4- R

(a) 1 (b) 0.1 (c) 0.01 (d) 10

9. Colburn analogy is applicable for the value of Prandtl number from CO5- R

(a) 0.5 to 5 (b) 0.6 to 120 (c) 120 to 400 (d) 0.001 to 1

10. jH factor for heat transfer depends upon the _____ number. CO5- R

(a) Prandtl (b) Nusselt (c) Reynolds (d) Biot

PART – B (5 x 2= 10 Marks)

11. For the incompressible flow the x and y components of the velocity vector are $V_x = 2 (x + y)$; $V_y = 2 (y + z)$ where x, y and z are in meters and the velocity are in m/s. Then show the z component of the velocity vector (V_z) of the flow for the boundary condition $V_z = 0$ at Z=0 is CO1- App

12. The distance between plates is $\Delta y = 0.5$ cm, $\Delta V_z = 10$ cm/sec, and the fluid is ethyl alcohol at 273K having a viscosity of 1.77cp. Estimate the shear stress τ_{yz} and the velocity gradient or shear rate. CO2- U

13. A plastic panel of area A=929cm^2 and the thickness Y=0.64cm was found to conduct heat at a rate of 3.0 Watts at steady state with temperatures of T_o=24^{o}C and T_1=26^{o}C on the two main surfaces. Estimate the thermal conductivity of the plastic at 25^{o}C CO3- App

14. Sketch the concentration profile when a component diffuses through a stagnant medium. CO4- U

15. State Von Karman similarity hypothesis? CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) Estimate the viscosity of N_2 at 50^{0}c and 854atm, given M=28gm/gm mole P_c=33.5atm, Tc=126.2K CO1- App (16)

Or

(b) Discuss in detail about the molecular theory of viscosity of the gases at low density. CO1- App (16)

17. (a) Calculate the required torque in N-m and the power consumption in horse power to turn the shaft in the friction bearing. The length of bearing surface on the shaft is 5.08 cm, that the shaft is turning at 200 rpm, that the viscosity of the lubricant is 200 cp, and that the fluid density is 243.8 kg/m^3. Inner radius=2.54X10^{-2}m, outer radius is 0.02545m. CO2- Ana (16)

Or

(b) Derive the differential equations of motion for a fluid of constant viscosity and density which is flowing over an impulsively accelerated, infinitely long horizontal flat plate. Assume that the flow is laminar. CO2 Ana (16)

18. (a) Derive the temperature distribution equation for fin and find the effectiveness of fin. CO3- App (16)

Or

(b) A frying pan has a handle with a rectangular cross section that is 3 mm thick and 3 cm wide. The point where the handle is attached to the pan has a temperature of 200°C. The desired temperature of the other side of the handle is 30°C. How long should the handle be if there is a convection coefficient of 18 3 $W/m^2 \cdot {}^oC$ to an ambient temperature of 20°C and the handle is (a) duralumin ($k = 180\ W/m \cdot {}^oC$) or stainless steel ($k = 53\ W/m \cdot {}^oC$). CO3- App (16)

19. (a) Carbon dioxide from an aqueous solution has to be removed by an air stream flowing at 3.0 ft/sec using 3 in. internal diameter wetted wall column. At one point in the column the CO_2 concentration in air stream is 1 mole percent and in the water is 0.5 mole percent. If the column is operated at 10 atm and 80°F, find the gas-phase mass transfer coefficient and the mass flux at that point in the column. CO4- App (16)

Or

(b) At the bottom of a cylindrical container is n-butanol. Pure air is passed over the open top of the container. The pressure is 1 atm and the temperature is 70°F. The diffusivity of air-n-butanol is $8.57 \times 10^{-6}\ m^2/sec$ at the given conditions. If the surface of n-butanol is 6.0 ft below the top of the container, calculate the diffusion rate of n-butanol. CO4- App (16)

20. (a) Use the diffusional analog of Equation for turbulent flow in circular tubes, and the Blasius formula for the friction factor, to obtain the following expression for the Sherwood number,
$Sh = 0.0160\ Re^{7/8}\ Sc^{1/3}$ (valid for large Schmidt numbers.1) CO5- App (16)

Or

(b) Relate the analogies between Momentum Heat and Mass Transport. CO5- App (16)