QP Code: RO20MTECH179 Reg. No | | | | | | | | | | | AR 19

GIET UNIVERSITY, GUNUPUR – 765022

M. Tech (Second Semester Examinations) – October' 2021

MPCCH2010 – ADVANCED TRANSPORT PHENOMENA

(Chemical Engineering)

Time: 2 hrs Maximum: 50 Marks

(The figures in the right hand margin indicate marks)

PART – A

Q.1. Answer ***ALL*** questions (2 x 10 = 20)

a. What is the physical significance of friction factor?
b. Define hydraulic radius.
c. Can friction factor correlations be used for unsteady flows? Justify.
d. Write the mathematical expression of Blake-Kozeny equation.
e. Compare Newtonian and polymeric fluids on stress-strain diagram.
f. Define Peclet number in forced convection heat transfer.
g. State the Colburn analogy equation.
h. Give examples of packed bed equipment where heat transfer coefficient is important.
i. Write the total Nusselt number equation for mixed free and forced convection heat transfer.
j. Write the differential form of mechanical energy balance equation.

PART – B **(6 x 5 = 30 Marks)**

Answer ***ANY FIVE*** questions Marks

2. What pressure gradient is required to cause a liquid (density=0.98 gm/cc and viscosity = 2 cp), to flow in a horizontal, smooth circular tube of inside diameter of 3cm at a mass flow rate of 1000 gm/sec at 25^0C? Friction factor at this flow is 0.0054. (6)

3. Derive the velocity profile equation for a non-Newtonian fluid (power law model) flow through a pipe. (6)

4. Discuss heat transfer coefficients for free and mixed convection heat transfer. (6)

5. A nuclear reactor with its core constructed of parallel vertical plates 2.2 m high and 1.4 m wide has been designed on free convention heating of liquid bismuth. The maximum temperature of the plate surfaces is limited to 960^0C while the lowest allowable temperature of bismuth is 340^0C. Calculate the maximum possible heat dissipation from both sides of each plate. $Nu=0.13\ [Gr.Pr]^{0.33}$ (thermo-physical properties of bismuth at 650^0C ρ=10000 kg/m^3, μ=3.12 kg/m-hr, C_p=150KJ/kg^{0}C, κ=13 W/m^{0}C) (6)

6. Derive the velocity profile equation for a non-Newtonian fluid (power law model) flow in a narrow slit. (6)

7. A hollow sphere 5 mm in diameter, with a mass of 0.0500 gm, is released in a column of liquid and attains a terminal velocity of 0.5 cm/s. The liquid density is 0.9 gm/cm^3. The local gravitational acceleration is 980.7 cm/sec^2. The sphere is far enough from the containing walls so that their effect can be neglected. (6)

   (i) Compute the drag force on the sphere in dynes.
   (ii) Compute the friction factor.
   (iii) Determine the viscosity of the liquid in centipoises

8. Differentiate between the flow in tubes and flow around the sphere. (6)

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