M. Tech. –I (Chemical Engineering) (CBCS – 2015 Course) : WINTER - 2018

SUBJECT: ADVANCED MOMENTUM AND HEAT TRANSFER

Day : Wednesday
Date : 05/12/2018

W-2018-3129

Time: 11.00 AM TO 02.00 PM
Max. Marks: 60.

N.B.:

1) All questions are **COMPULSORY.**
2) Figures to the **RIGHT** indicate full marks.
3) Both the sections should be written in **SEPARATE** answer books.
4) Draw neat diagrams **WHEREVER** necessary.
5) Assume suitable data, if necessary.

SECTION-I

Q.1 What is the science of Rheology? Discuss in detail about various rheological models for non-Newtonian fluids. **(10)**

OR

A Newtonian fluid is in laminar flow in a narrow slit formed by two parallel walls a distance 2B apart. It is understood that B << W, so that edge effects are unimportant. Make a differential momentum balance and obtain the following expressions: **(10)**

$$\tau_{xz} = \left[\frac{P_0 - P_L}{L}\right] x$$

$$v_z = \frac{(P_0 - P_L)B^2}{2\mu L}\left[1 - \left(\frac{x}{B}\right)^2\right]$$

Q.2 Derive the equation of motion: **(10)**

$$\rho \frac{Dv}{Dt} = -\nabla P - (\nabla \cdot \tau) + \rho g$$

OR

Discuss time dependence of velocity in turbulent flow for (i) steady mean flow and unsteady mean flow. Also describe the mixing length hypothesis. **(10)**

Q.3 Compare and contrast the friction factor curves for flow in tubes and flow in packed column. Describe the equations to calculate frictions factor for both the cases. **(10)**

OR

Discuss about the formulation of macroscopic balances and explain: **(10)**

a) Macroscopic mass balances (steady and unsteady state).
b) Macroscopic momentum balances (steady and unsteady state)..
c) Macroscopic mechanical energy balances (steady and unsteady state)..

SECTION-II

Q.4 Consider a rectangular fin with length L, width W and thickness 2B. Set up a differential energy balance and derive an expression for temperature distribution as **(10)**

$$\theta = \frac{\cosh N(1-\zeta)}{\cosh N}$$

OR

P.T.O.

For free convection between two vertical plates at two different temperatures, obtain an expression for velocity distribution as **(10)**

$$v_z = \frac{(\rho g \beta \Delta T) B^2}{12\mu}\left[\left(\frac{y}{B}\right)^3 - \left(\frac{y}{B}\right)\right].$$

Q.5 **a)** Describe the equation of energy for non-isothermal system and state the special form of equation of change for internal energy and temperature. **(05)**

b) Discuss the empirical expressions for the turbulent heat flux. **(05)**

OR

Derive the temperature profile equation of unsteady state heat conduction near wall with a sinusoidal heat flux. **(10)**

Q.6 Write a note on Heat transfer coefficients for condensation of pure vapors on solid surfaces. **(10)**

OR

Discuss in detail the analytical calculations of heat transfer coefficients for forced convection through tubes and slits. **(10)**

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