M. TECH. –I (CHEMICAL ENGINEERING) (CBCS – 2015 COURSE)
: WINTER - 2017

SUBJECT : ADVANCED MOMENTUM & HEAT TRANSFER

Day : **Wednesday** **W-2017-2797** Time **11.00 AM TO 02.00 PM**
Date : **17/01/2018** Max. Marks : 60

N.B.

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Answers to both the sections should be written in **SEPARATE** answer book.

SECTION – I

Q.1 Consider the steady state, laminar flow of a fluid of constant density ρ and viscosity μ in a vertical tube of length L and radius R. The fluid flows downward under the influence of a pressure difference and gravity. Make a differential momentum balance and determine the expressions for: **(10)**

i) Momentum flux distribution
ii) Velocity distribution

OR

Discuss the two and three parameter rheological models for Non-Newtonian fluids in detail.

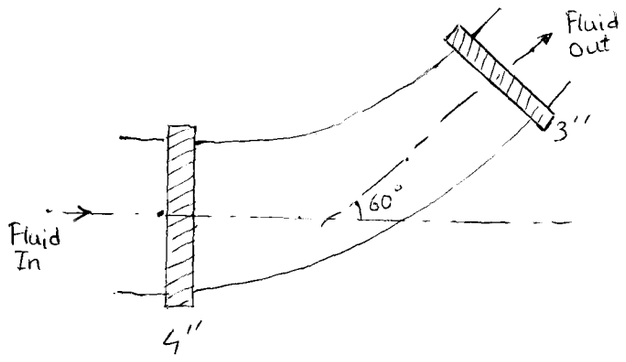
Q.2 Derive the continuity equation **(10)**

$$\frac{\partial \rho}{\partial t} = -(\nabla . \rho v)$$

OR

Describe turbulence and discuss in detail about the turbulent boundary layer on a flat plate.

Q.3 Water at 95^0C is flowing at a rate of 2.0 ft^3/sec through a 60^0 bend, in which there is a contraction from 4 to 3 inch internal diameter. Compute the force exerted on the bend if the pressure at the downstream end is 1.1 atm. The density and viscosity of water at the conditions of the system are 0.962 g/cm^3 and 0.299 cp respectively. **(10)**



OR

Discuss friction factors for tube flow.

What pressure gradient is required to cause diethylaniline ($C_6H_5N(C_2H_5)_2$) to flow in a horizontal, smooth, circular tube of inside diameter D = 3 cm at a mass rate of 1028 g/sec at 20^0C? At this temperature the density of diethylaniline is ρ=0.935 g/cm^3 and its viscosity is μ=1.95 cp.

P.T.O.

SECTION – II

Q.4 For a laminar free convection flow between two vertical plates at two different temperatures, derive the following velocity profile equation. **(10)**

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

OR

Derive the following equation : $\eta = \frac{\tanh N}{N}$ for heat transfer through a cooling rectangular fin. State the assumption.

Q.5 Discuss the temperature distribution for turbulent flow in tubes for a circular tube of radius r =R in detail. Explain the relations with respect to Prandtl number. **(10)**

OR

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

Q.6 Discuss heat transfer coefficients for condensation of pure vapors on solid surfaces. **(10)**

OR

Explain Chilton and Colburn analogy between momentum and heat transfer.

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