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Total number of printed pages – 02

**B.TECH**

**PCBT4303**

**5<sup>th</sup> Semester Regular/ Back Examination 2015-16  
UPSTREAM PROCESS ENGINEERING  
BRANCH :BIOTECHNOLOGY**

**Time : 3 Hours**

**Max Marks : 70**

**Question Code : T501**

*Answer Question No. 1 which is compulsory and any FIVE from the rest.*

*The figures in the right-hand margin indicate marks.*

*Answer all parts of a question at a place.*

**1. Answer the following questions :**

**2 x 10**

- (a) What is Reynolds number .Calculate friction factor when Reynolds number is 1600, when flow of fluid is takes place through pipe?
- (b) Calculate the head loss due to friction of smooth pipe having diameter 400 mm, length 800 m carries water at a rate of  $0.04 \frac{m^3}{sec}$  of kinematic viscosity  $0.018 \times 10^{-4} \frac{m^2}{sec}$  and Reynolds number  $7.073 \times 10^4$ .
- (c) Define Boundary Layer thickness concept
- (d) A hot fluid enters a DPHE at a temperature of  $150^\circ c$  and is to be cooled to  $94^\circ c$  by a cold fluid entering at  $38^\circ c$  and heated to  $66^\circ c$  .Shall they directed in parallel or counter-current.
- (e) What are Momentum equation and its correction factor?
- (f) Write the corrected form of Bernoulli's equation for real fluid by taking correction factor.
- (g) Estimate the heat loss per  $m^2$  of the surface through a brick wall 0.5 m thick when the inner surface id at 400 K and the outer surface is at 310 K .The thermal conductivity of the brick may be taken as  $0.7 W/(m.K)$ .
- (h) Find the overall heat transfer coefficient from the following data  $LMTD = 23 K$  ,Area =  $1.5 m^2$ ,  $Q = 116 KW$  ,  $F_T = 0.85$
- (i) State Ficks law of diffusion.
- (j) What is Constant Pressure and Constant rate of filtration.

2. (a) Draw the shear stress and velocity distribution of a viscous fluid flowing in a horizontal pipe. 3
- (b) Using Fanning equation derive the expression for determining pressure drop and loss of head due to friction in a circular pipe of diameter D and length L in turbulent flow region and in viscous region. 7
3. (a) The diameter of pipe at the section 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section-1 is  $5 \frac{m}{sec}$ . Determine the velocity at section-2. 3
- (b) Derive Bernoulli's Equation for ideal fluid mentioning the necessary assumption. Also write the corrected form of Bernoulli's equation for real fluid by taking correction factor. 7
4. (a) Derive the expression for heat transfer through furnace wall made of three different materials in series. Assume  $K_1, K_2$  and  $K_3$  the thermal conductivities of materials and  $X_1, X_2, X_3$  be the respective thickness. Assume hot face and cold face temperature be  $T_1$  and  $T_2$  respectively. 5
- (b) Derive the expression for heat flow through thick walled cylinder ( $r_1$  and  $r_2$  as inside radius and outside radius) lagged with a layer of insulation.  $K_1$  and  $K_2$  are the thermal conductivity of material and insulating materials. Assume  $r_3$  be the outer radius of insulation, inside temperature  $T_1$  and temperature at the outer surface of insulation as  $T_2$ . 5
5. (a) Draw the neat sketch of 1-2 shell and tube heat exchanger and label its parts. 2
- (b) Derive the expression for overall heat transfer coefficient in case of combined conduction and convection. 8
6. (a) What do you mean by size reduction? Write some of the size reduction equipments. 5
- (b) What is screening? Discuss some of the industrial screening equipments. 5
7. Write in brief with sketches on fractionating column. Derive the operating line equation for rectifying section and stripping section. 10
8. **Write short notes on any two:** 5 x 2
- (a) Azeotropic Distillation.
- (b) Rayleigh's equation for Differential distillation.
- (c) Single Stage Adsorption Isotherm.
- (d) Critical thickness of insulation.