Registration No. : | | | | | | | | | | |

Total number of printed pages – 2

B. Tech

PCBT 4303

Fifth Semester Examination – 2013

UPSTREAM PROCESS ENGINEERING

BRANCH : BIOTECH

QUESTION CODE : C- 447

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10
   (a) What is Azeotropes ?
   (b) Describe the concept of thermal boundary layer ?
   (c) What do you mean by incompressible fluid ?
   (d) Write down the expression of relative volatility.
   (e) Calculate the friction factor when the Reynolds number is 1600 for flow of fluid through pipe.
   (f) What is kinetic energy correction factor ?
   (g) What is the principle of centrifugation ?
   (h) Briefly differentiate between Newtonian and non-Newtonian fluids.
   (i) Write down the expression of Grashoff's number.
   (j) State the SI unit of rate of heat flow.

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2. (a) With neat sketches, define co-current and counter-current flow in a heat exchanger. At steady state, briefly write the energy balance for a heat exchanger. 5
   (b) A liquid stream is cooled from 70°C to 32°C in a double pipe heat exchanger. Fluid flowing counter currently with this stream is heated from 20 °C to 44°C. Calculate Log-mean temperature difference (LMTD). 5

P.T.O.

3. (a) Describe the process of one-dimensional steady state heat transfer by conduction. 5

(b) A cylinder tube has inner diameter of 20 mm and outer diameter of 30 mm. Find out the rate of heat flow from tube of length 5 m if inner surface is at 100 ^{0}C and outer surface is at 35^{0}C. Take thermal conductivity of tube material as 0.291 w/m ^{0}C. 5

4. What is shear stress distribution of a fluid in a pipe ? Using Fanning equation derive an expression for determining the pressure drop and head loss due to friction in a Turbulent flow of a fluid through circular pipe of diameter D and length L. 10

5. Write short notes on : 5+5

(a) Continuity equation

(b) Fick's law of diffusion.

6. (a) What is film-wise condensation ? How it differs from drop-wise condensation ? 5

(b) Briefly write the energy balance and mass balance of heat transfer equipments, with reference to evaporator system. 5

7. (a) Using Rayleigh equation, derive an expression for determining the material balance of binary mixture in a differential or simple distillation unit. 5

(b) A mixture of benzene and toluene boils at 368 K (95^{0}C) under a pressure of 101.325 KPa. Determine the composition of the boiling liquid assuming that mixture obeys Raoult's Law. At 368 K (95^{0}C), the Vapour pressure of benzene is 155.56 KPa and that of toluene is 63.98 KPa. 5

8. Write short notes on any **two** of the following : 5×2

(a) Characterization of solid particles

(b) Variable head meter

(c) Convectional heat transfer

(d) Adsorption.

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