Total number of printed pages – 2

B. Tech

PCBT 4303

Fifth Semester Back Examination – 2014

UPSTREAM PROCESS ENGINEERING

BRANCH : BIOTECH

QUESTION CODE : L 258

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 do you understand by Reynolds number ?
   (b) In what way is the science of heat transfer different from thermodynamics ?
   (c) Types of Mass Transfer Coefficients.
   (d) What is meant by boundary layer thickness ?
   (e) 5.6 m^3 of oil weighs 46,800 N. Find its mass density and relative density.
   (f) What are the advantages of distillation over absorption ?
   (g) State Fourier's law of heat conduction.
   (h) Distinguish between film type and drop-wise condensation.
   (i) Give expression for :
       (i) Stanton number and
       (ii) Grashoff number.
   (j) Explain the equation of continuity.

2. (a) Discuss the factors which govern the selection of solvents to be used for liquid-liquid extractions.   5
   (b) Explain Fick's law of diffusion and also explain Raoult's law in mass transfer.   5

3. (a) What do mean by heat transfer ? What are the different modes of heat transfer ? Discuss the differences between them ?   5
   (b) A tap discharges water evenly in a jet at a velocity of 2.6 m/s at the tap outlet, the diameter of the jet at this point being 15 mm. The jet flows down

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vertically in a smooth stream. Determine the velocity and the diameter of the jet at 0.6 m below the tap outlet. [Hint- The pressure around the jet is atmospheric throughout. Taking the tap outlet as point 1 and also taking it as the datum]

5

4. (a) Derive Fourier's law of heat conduction and thermal conductivity with assumption that are made during derivation.

5

(b) A composite wall is made up of two layers of 0.5 m and 0.2 m thicknesses with temperature held at the outer surfaces are 300°C and 50°C respectively. If the heat conductivity is 20 W/mK and 40 W/mK. Then determine the heat conducted. In order to reduce heat loss to 5 kW/Sqm, a additional layer of thickness of 0.15 m was proposed to introduce, then determine the thermal conductivity of the material.

5

5. (a) Newtonian and non-Newtonian fluids. Explain with types and examples. 5

(b) Differentiate between adsorption and absorption. Explain different types of adsorption.

5

6. Using Hagen-poiseulle equation derive an expression for the head loss in a pipe of diameter D and length L in terms of Reynolds number and velocity head. 10

7. (a) A pipe having diameters 20 cm and 10cm at two sections A and B, carries water that flows at a rate 40 Lts/s. Section A is 5 m above datum and section 'B' is 2 m above datum. If the pressure at section A is 4 bar, find the pressure at section 2.

5
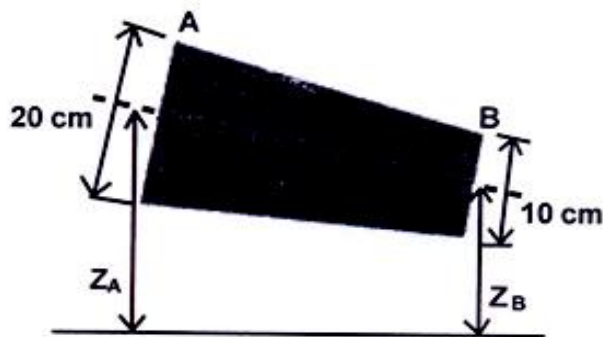
(b) With neat sketches, define co-current and counter-current flow in heat exchangers. A steady state, do the energy balance for a heat exchanger. 5

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

(a) Reverse osmosis

(b) Azeotropes

(c) Salt precipitation.

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