Registration no: | | | | | | | | | | |

Total Number of Pages: 2 **B.Tech**
PCBT4303

5th Semester Regular / Back Examination 2016-17
UPSTREAM PROCESS ENGINEERING
BRANCH: BIOTECH
Time: 3 Hours
Max Marks: 70
Q.CODE: Y171

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

Q1 **Answer the following questions:** **(2 x 10)**

a) Explain the Concept of Continuum.

b) Define Newtonian fluids.

c) Define thermal Diffusivity and state its dimension.

d) What do mean by uniform heat transfer?

e) Determine the flow pattern, if a fluid flows through a diameter of 80 mm with velocity 5 m/s having density of 1400 Kg/m^3 and having viscosity of 0.9 Kg/ms.

f) Define Rauolt's law. What is its significance?

g) What are azeotropes?

h) Define Nusselt number and its physical significance.

i) Calculate Log Mean Temperature Difference (LMTD) for shell and tube exchanger for counter-current and co-current flow? (Hot fluid inlet and outlet temperature are 100 ^{0}C and 75 ^{0}C and cold fluid inlet and outlet temperatures are 20 ^{0}C and 55 ^{0}C.)

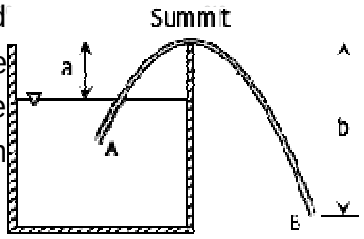
j) What is meant by steam distillation?

Q2 **a)** What is Darcy's friction factor? **(3)**

b) 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. **(7)**

Q3 **a)** Derive Newton's Law of Viscosity with diagram. **(5)**

b) In Figure shown, a siphon discharging water from reservoir A into the air at B. Distance 'a' is 1.8 m, 'b' is 6 m, and the diameter is 150 mm throughout. If there is a frictional loss of 1.5 m between A and the summit, and 1.5 m between the summit and B, what is the absolute pressure at the summit in kiloPascal? Also determine the rate of discharge in cubic meter per second and in gallons per minute. **(5)**



Q4 **a)** State Fourier's law of heat conduction with assumptions and derive expression fro overall heat transfer through surface. **(5)**

b) A steel pipe with 50 mm outer diameter is covered with a 6.4 mm asbestos insulation [k= 0.166 W/mK] followed by a 25 mm layer of fiber-glass insulation [k= 0.0485 W/mK]. The pipe wall temperature is 120 0 C and the outside insulation temperature is 38 0 C. Calculate the interface temperature between the asbestos and fiber- glass? **(5)**

Q5 **a)** Derive from first principles an expression for steady state diffusion of a liquid species A through a stagnant liquid species B. **(5)**

b) Calculate the vapor pressure of a solution of 74.0 g of benzene (C_6H_6) in 48.8 g of toluene (C_7H_8) at 25.0 °C. The vapor pressure of benzene is 95.1 torr and of toluene is 28.4 torr at this temperature. **(5)**

Q6 **a)** The temperature distribution profile across the thickness from one side of a wall is given by $T = 5x^2 - 24x$ where T is in °C and x is in metres. Calculate the heat flux across the wall at x = 10 cm and x = 20 cm. Thermal conductivity (K) of the wall is 50 W/m°C. **(3)**

b) Define thermal boundary layer and its characteristics with diagram? Explain BL thickness and displacement with equations for both laminar and turbulent flow. **(7)**

Q7 Define absorption and absorption factor. What are the different types of adsorption process and illustrate different criteria's of good adsorbents? **(10)**

Q8 Write short notes on ***any two***: **(5 x 2)**

a) Rayleigh's equation for Differential distillation.

b) Pitot tube with Diagram

c) Critical thickness of insulation

d) Rotary dryers