Register Number: ……..

M.TECH DEGREE EXAMINATIONS: JANUARY 2011

First Semester

BIOTECHNOLOGY

BTY505: Chemical Process Engineering

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:
PART A (10 x 2 = 20 Marks)

1. Define Dimensional Analysis.
2. Distinguish between closed system and open system.
3. Differentiate between Newtonian and Non-Newtonian fluids
4. Define fanning friction factor. Give friction factor equations for laminar and turbulent flow.
5. What are the modes of heat transfer and define it with examples?
6. For a plane wall (thermal conductivity k and thickness x) with convection heat transfer coefficients hi and ho on the two sides how do you define overall heat transfer coefficient u?
7. Define filter media and filter aids .Give some examples.
8. Define the term diffusivity
9. What is meant by on-off control?
10. What are the objectives of automatic process control?

PART B (5 x 16 = 80 Marks)

11.(a) (i) By electrolyzing a mixed brine, a gaseous mixture is obtained at the cathode having the following composition by weight: Cl_2=67%, Br_2=28% and O_2=5% .Calculate (I) composition of gas by volume, (II) average molecular weight and (III) density of gas mixture at 298K and 101.325 kPa (8)

(ii) The dilute acid containing 25% H_2SO_4 is concentrated by commercial grade sulphuric acid containing 98% H_2SO_4 to obtain desired acid containing 65% H_2SO_4. Find the quantities of the acids required to make 1000kg of desired acid. (8)

(OR)

(b) (i) An evaporator is fed with 15000 kg/hr of a solution containing 10% NaCl, 15% NaOH and rest water. In operation water is evaporated and NaCl is precipitated as crystals. The thick liquor leaving the evaporator contains 45% NaOH, 2% NaCl and rest water.Calculate (I) kg/h water evaporator,(II) kg/h salt precipitated, (III) kg/h thick liquor (9)

(ii) A fluid is flowing external to a solid body. The force 'F' exerted on the body is a function of the fluid velocity 'v', fluid density 'ρ',fluid viscosity 'μ', and a dimension for the body 'L'. By dimensional analysis, obtain the dimensionless group form the variable. (Note: use the M, L, T system of units). (7)

12. (a) Derive the Bernoulli's equation for the steady flow of fluids. Give some applications of Bernoulli's equation.

(OR)

(b) Explain the function of Centrifugal and Piston pump with a neat sketch.

13. (a) (i) Derive a relationship between heat flux and temperature difference when heat transfer takes place by conduction through a hollow cylinder. (8)

(ii) A thick walled cylindrical tubing of hard rubber having an inside radius of 5mm and an outside radius of 20mm is being used as a temporary cooling coil in a bath. Ice water is flowing rapidly inside and the inside wall temp is 274.9K. The outside surface temperature is 297.1K. A total of 14.65 W must be removed from the bath by the cooling coil. How many meter length 0f tubing are needed? If K=0.151 W/mK (8)

(OR)

(b) With a neat diagram explain the following:

1] Double pipe heat exchanger (5)
2] Shell and tube heat exchanger (6)
3] Cross-flow heat exchanger (5)

14. (a) (i) Derive from first principles an expression for steady state diffusion of a liquid species A through a stagnant liquid species B. (8)

(ii) Discuss the need for defining the interphase mass transfer resistance in terms of overall coefficients. How they are related to individual coefficients? (8)

(OR)

(b) (i) Data for the laboratory filtration of $CaCo_3$ slurry in water at 298.2K (25^0C) are reported as follows at a constant pressure ($-\Delta P$) of 338kN/m^2. The filter area of the plate frame press was A= 0.0439m^2 and the slurry conc. was Cs=23.47 kg/m^3. Calculate α and R_m from the data given, where t is the time in s and V is filtrate volume collected in m^3.

t	4.4	9.5	16.3	24.6	34.7	46.1	59.0	73.6	89.4	107.3
$Vx10^{-3}$	0.498	1	1.501	2	2.498	3.002	3.506	4.004	4.502	5.009

At 298.2K, the viscosity of water is assumed to be =8.937 x 10^{-4} kg/ms (9)

(ii) Obtain an expression for determining the rates of settling in centrifuges? (7)

15. (a) Discuss with neat sketches the working of the following:

(1) Orifice meter (5)
(2) hot-wire anemometer (6)
(3) Venturimeter (5)

(OR)

(b) (i) Explain with neat sketches the measurement of temperature using thermocouples and resistance thermometers. (10)

(ii) Indicate the important components of a control system. (6)

****