Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent institution of MAHE, Manipal)

III SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, Nov/Dec 2018

SUBJECT: Bioprocess Calculations [BIO 2104]

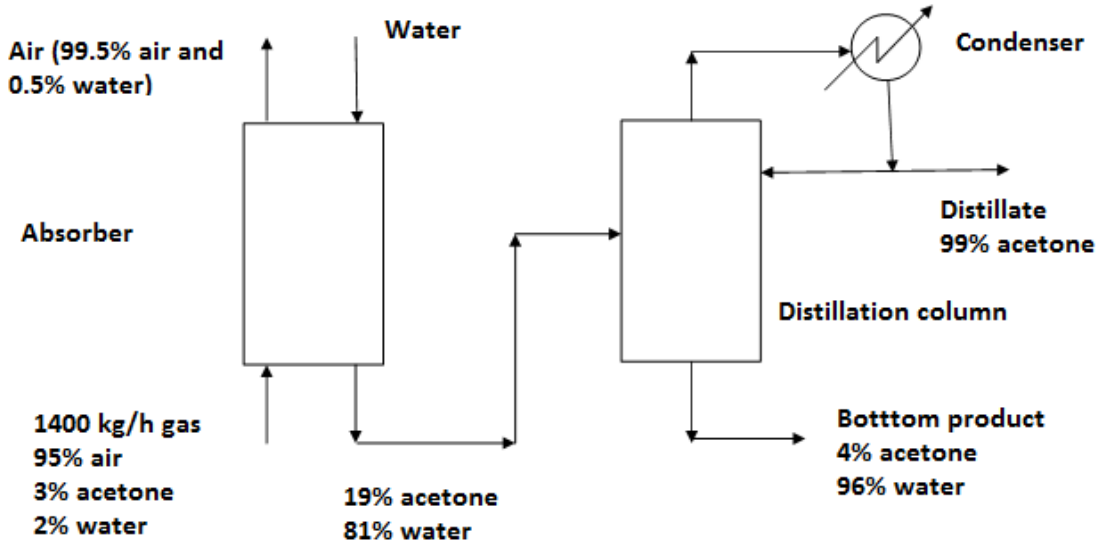
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	In biological systems, enzymes are used to accelerate the rates of certain biological reactions. Glucoamylase is an enzyme that aids in the conversion of starch to glucose. Experiments show that 1 µg mol of glucoamylase in a 4% starch solution results in a production rate of glucose of 0.6 µg mol/(mL. min). Determine the production rate of glucose for this system in the units of lb mol/(ft^3 .day)?	**2**
1B.	The density of a fluid is given by $\rho = 70.5 \exp(8.27 \times 10^{-7} P)$ where, ρ is density (lb_m/ft^3) and P is pressure (lb_f/in^2) Derive the formula for ρ, g/cm^3 as a function of P (N/m^2)	**3**
1C.	Discuss the different steps involved in Bioprocess development with a neat flow diagram.	**5**
2A.	A solution of caustic soda contains 20% NaOH (MW=40) by weight. Taking density of the solution as 1.196 kg/L. find normality, molarity and molality of the solution	**3**
2B.	Natural gas is piped from the wall at 300 K and 400 kPa. The gas is found to contain 93 % methane, 4.5 % ethane and the rest nitrogen (mole %). Calculate the following: a) The pure component volume of ethane in 10 m^3 of the gas b) The composition in weight percent	**3**
2C.	Aerobic degradation of benzoic acid by a mixed culture of microorganisms can be represented by the following reaction. $C_6H_5COOH + a\ O_2 + b\ NH_3$ --------> $c\ C_5H_7NO_2 + d\ CO_2 + e\ H_2O$ Determine the coefficients a, b, c, d, and e where RQ=0.9	**4**
3A.	Find the value of the gas constant R in $\frac{m3\ .mmHg}{mol\ K}$ and $\frac{Cal}{mol.K}$ using STP conditions of ideal gas.	**3**
3B.	3000 kg/h of solution containing 10 wt % NaOH is evaporated in the first evaporator giving a 20% NaOH solution. This is then fed in to a second evaporator, which gives a product of 50% NaOH. Calculate the following.	**3**

	a) The amount of water removed from each evaporator. b) The feed to the second evaporator in kg/hr. c) The amount of product in kg/hr.	
3C.	For the filtration of a cell broth, the constant pressure filtration was employed. During the process the following observations were made and observed. Time (min): 3, 15, 45, 65, 110 Volume(V) in L: 90, 300, 650, 820, 1150 The above data follows the following equation. $\frac{t}{V} = \frac{1}{K}(V + 2V_o)$ Calculate **K** and V_o by plotting the data.	**4**
4A.	Figure represents the flow sheet for the recovery of acetone from air. All compositions are on a weight basis. Make a material balance and determine the quantities of the following streams. a) Water added in the absorber b) Acetone-free air leaving the absorber c) Aqueous solution of acetone leaving the absorber d) Distillate product e) Bottom Product 	**10**
5A.	Commercial nitric acid is produced by the catalytic air oxidation of ammonia, according to the following equation $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ This reaction goes to 95 % completion. It is followed by the reaction, $4NO + 3O_2 + 2H_2O \rightarrow 4HNO_3$ This reaction goes to 98 % completion. Calculate the amount of ammonia in kg required for producing 650kg of nitric acid	**5**
5B.	A stream flowing at a rate of 15000 mole/h containing 25 mole% N_2 and 75 mole% H_2 is to be heated from 298 K to 473 K. calculate the heat that must be transferred using C_P data given below: $C_P = a + bT + cT^2 + dT^3$, kJ/(kmol.K)	**5**

Gas	a	b	c	d
N2	29.5909	$-5.41*10^{-3}$	$13.1829*10^{-6}$	$-4.968*10^{-9}$
H2	28.6105	$1.0194*10^{-3}$	$-0.1476*10^{-6}$	$0.769*10^{-9}$