Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent institution of MAHE, Manipal)

III SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS

SUBJECT: Bioprocess Calculations [BIO 2152]

REVISED CREDIT SYSTEM

Time: 85 Minutes MAX. MARKS: 20

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 1.6 µg mol/(mL. min). Determine the production rate of glucose for this system in the units of lb mol/(ft^3 .day)?	**3**
1B	An electric heating coil is immersed in a stirred tank. Solvent at 15 °C with heat capacity 2.1 $\frac{kJ}{kg.°C}$ is fed into the tank at a rate of 18 kg/h. Heated solvent is discharged at the same flow rate. The tank is filled initially with 135 kg cold solvent at 12 °C. The rate of heating by the electric coil is 850 W. Calculate the time required for the temperature of the solvent to reach 63 °C. Assume that heat capacity is independent of temperature	**4**
1C	Uric acid is degraded by uricase enzyme immobilized in porous Ca- alginate beads. The following data were obtained at different bulk uric acid concentrations. S(mg/L): 10, 25, 50, 100, 200, 250 V(mg/(L*h)): 10, 20, 30, 40, 45, 46 Plot the graph and calculate K_m and V_{max}. The data follows MM Kinetics. $\mathbf{v} = \frac{v_{max}*[S]}{K_m+[S]}$	**3**
2A	Two streams enter a column, stream 1 is 30% A and the rest B. stream 2 is 40% A and the rest C. Two streams exit the column, stream 3 is 100% A, while stream 4 is 20% B and the rest A and C. Write the material balance for the system.	**2**

2B	Aqueous two-phase extraction is used to purify a recombinant HIV-β-galactosidase fusion peptide produced in Escherichia coli. For optimum separation, 450 kg of a mixture of 19.7 % w/w polyethylene glycol (PEG) and 17.7% w/w potassium phosphate in water is needed. Left over from previous pilot-plant trials is 100 kg of a mixture of 20% w/w PEG in water, and 150 kg of a mixture of 20% w/w PEG and 25% w/w potassium phosphate in water. Also, on hand is 200 kg of an aqueous stock solution of 50% w/w PEG, 200 kg of an aqueous stock solution of 40% w/w potassium phosphate, and an unlimited supply of extra water. If all of both leftover mixtures must be used, how much of the PEG stock solution, potassium phosphate stock solution and water is required.	**3**
2C	The enzyme, glucose oxidase, is used commercially to remove glucose from dehydrated egg to improve colour, flavour and shelf-life. The reaction is: $C_6H_{12}O_6 + O_2 + H_2O \rightarrow C_6H_{12}O_7 + H_2O_2$ (glucose) (gluconic acid) A continuous-flow reactor is set up using immobilised-enzyme beads which are retained inside the vessel. Dehydrated slurry containing 2% glucose, 20% water and the remainder unreactive egg solids, is available at a rate of 3,000 kg/h. Air is pumped through the reactor contents so that 18 kg oxygen are delivered per hour. The desired glucose level in the dehydrated egg product leaving the enzyme reactor is 0.2%. Determine: (a) Which is the limiting substrate; (b) the percentage excess substrate; (c) the composition of the reactor off-gas; and (d) the composition of the final egg product.	**5**