Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, NOV/DEC 2018 (REGULAR)

SUBJECT: BIOREACTION ENGINEERING (BIO 3104)

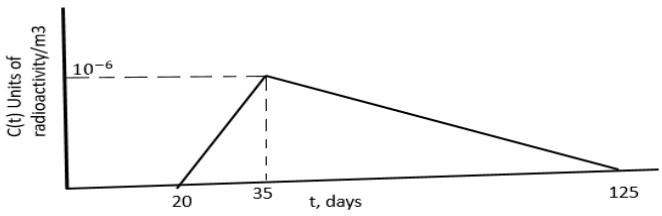
REVISED CREDIT SYSTEM

Time: 3 Hours (28/11/2018) MAX. MARKS: 50

Instructions to Candidates:

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

1A.	How do you define the reaction rate for the following two situations i. Homogeneous reaction system of hydrolysis of sucrose in a shake flask ii. Heterogeneous reaction system of hydrolysis of sucrose in an immobilized packed bed bioreactor	**2**
1B.	The secondary metabolites (P and Q) are produced using *Bacillus* species in submerged fermentation process. The following mechanism has been proposed. A $\Leftrightarrow$ P + Q* Q* $\rightarrow$ R* +S R*+Q*$\rightarrow$ 2P A is a substrate, P and S are metabolic products and R*& Q* are intermediates. Prove that above proposed mechanism is consistent with and can explain the observed first order decomposition of substrate A	**4**
1C.	A zero order homogeneous gas reaction A $\rightarrow \gamma$ R proceeds in a constant-volume batch reactor, π=1 when t=0 and π=1.5 when t=1 hour. If the same reaction, same feed composition and initial pressure proceeds in a constant pressure setup, find V at t=1 if V=1 at t=0.	**4**
2A.	An aqueous feed of A and B (400 liter/min, 100 mmol A/liter, 200 mmol /liter) is to be converted to product in a plug flow reactor. The kinetics of the reaction is represented by A + B $\rightarrow$ R, $-r_A = kC_AC_B \frac{mol}{liter.\min}$ Find the volume of reactor needed for 99.9% conversion of A to product. K=200 Liter/gmole.min	**4**
2B.	What do you mean by homogeneous catalyzed reactions? Explain how do you plan your kinetic runs to evaluate the kinetics of homogeneous catalyzed reaction of the following elementary scheme: A $\rightarrow$ R, k_1 A +C $\rightarrow$ R+C, k_2	**3**

2C	Write the i. Design equations of recycle reactor and represent them graphically. ii. Condition for optimum recycle ratio and represent it graphically	**3**
3A.	Substrate A decomposes in a batch fermenter as follows: A → Product. The composition of A in the fermenter is measured at various times with results shown in the following table. Find the rate equation to represent the data using differential method of analysis. Time, h: 0, 20, 40, 60, 120, 180, 300 C_A, M: 10, 8, 6, 5, 3, 2, 1	**5**
3B.	A homogeneous liquid phase reaction A → R, $-r_A = kC_A^2$ Takes place with 50% conversion in a mixed reactor i. What will be the conversion if this reactor is replaced by one 6 times as large-all else remaining unchanged? ii. What will be the conversion if the original reactor is replaced by a plug flow reactor of equal size-else remaining unchanged?	**5**
4A.	We wish to treat 10liters/min of liquid feed containing 1 mol A/liter to 99% conversion. The stoichiometry and kinetics of the reaction are given by $A \rightarrow R, \qquad -r_A = \frac{1C_A}{0.2+C_A} \frac{mol}{liter.\min}$ Suggest a good arrangement for doing this using two mixed flow reactors, and find the size of the two units needed. Sketch the final design chosen.	**5**
4B.	How do you operate the chemostat at steady state? With the help of operating diagram explain the critical dilution rate and washout. Derive the suitable expression for optimum dilution rate for Monod growth kinetics.	**5**
5A.	Write on RTD of the following cascade reactor system i. PFR followed by MFR ii. MFR followed by PFR	**4**
5B.	A batch of radioactive material is dumped into the Columbia River at Hanford, Washington. At Bonneville Dam, about 400 km downstream the flowing waters (6000 m3/s) are monitored for a particular radioisotope ($t_{1/2}$>10 years) and the data of following are obtained. i. How many units of this tracer were introduced into the river? ii. What is the volume of Columbia River waters between Bonneville Dam and the point of introduction of tracer?  	**4**
5C	Write on the properties of tracer material that is used in RTD experiment.	**2**