Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VI SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, April/May 2018

SUBJECT: Biopharmaceutical Engineering [BIO 4010]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A.	Briefly explain the following terms: (a) Biopharmaceutics (b) Clinical Pharmacokinetics (c) Toxicokinetics	**3**
1B.	Why is plasma or serum drug concentration, rather than blood concentration, used to monitor drug concentration in the body?	**1**
1C.	Discuss briefly the following terms: (a) Active Transport (b) Vesicular Transport (c) Ion pair formation	**6**
2A.	Let $pK_a = 5$ for an acidic drug. Calculate the percentage of drug ionized at urinary pH 3	**2**
2B.	If the pH on one side of a cell membrane differs from the pH on the other side of the membrane, what conclusions you make based on pH–partition hypothesis?	**3**
2C.	A pharmacist dissolved a few milligrams of a new antibiotic drug into exactly 100 mL of distilled water and placed the solution in a refrigerator (5°C). At various time intervals, the pharmacist removed a 10-mL aliquot from the solution and measured the amount of drug contained in each aliquot. The following data were obtained. Time (hr): 0.5, 1, 2, 4, 6, 8, 12 Antibiotic (µg/mL): 84.5, 81.2, 74.5, 61, 48, 35, 8.7 (a) Is the decomposition of this antibiotic a first-order or a zero-order process? (b) What is the rate of decomposition of this antibiotic? (c) How many milligrams of antibiotics were in the original solution prepared by the pharmacist?	**3**
2D.	How many half-lives ($t_{1/2}$) would it take for 80 % of any initial concentration of a drug to decompose? Assume first-order kinetics.	**2**
3A.	Penicillin has a Cl_T of 15 mL/min. Calculate the elimination rate for penicillin when the plasma drug concentration, C p, is 2 µg/mL	**2**
3B.	70 kg female patient received 100 mg of drug x through IV Injection. A urine samples have been collected as follows:	**4**

Time Interval (hr)	0 - 1	1 - 2	2 - 4	4 - 6	6 – 9	9 - 12
Amount of drug in urine (mg)	9.7	6.7	6.2	3.4	1.5	0.63

a) The half – life for drug X.
b) Total elimination rate constant
c) Renal elimination rate constant
d) Fraction of drug excreted unchanged renally

3C. Studied the pharmacokinetics of amrinone after a single IV bolus injection (75 mg) in 14 healthy adult male volunteers. The pharmacokinetics of this drug followed a two-compartment open model and fit the following equation: $C_p\,(mg/L) = 4.62e^{(-8.94t)} + 0.64e^{(-0.19t)}$
From these data, calculate:
(a) The volume of the central compartment
(b) The volume of distribution at steady state
(c) The extrapolated volume of distribution
(d) The volume of distribution by area — **4**

4A. Plasma samples from a patient were collected after an oral bolus dose of 10 mg of a new benzodiazepine solution as follows: — **5**

Time (hr)	0.25	0.5	0.75	1	2	4	6	10	14	20
Concentration(ng/mL)	2.85	5.43	7.75	9.84	16.20	22.15	23.01	19.09	13.9	7.97

From the data above:
(a) Determine the elimination constant of the drug.
(b) Determine k_a by feathering.

4B. Derive the mathematical expression to calculate absorption rate constant when the drug is given orally using urinary date (Assume drug is eliminating by first order and follows one compartment model) — **5**

5A. Develop the mathematical expression to calculate drug concentration after nth dose when the drug is given by multiple IV injections to a patient? — **4**

5B. An adult male patient (46 years old, 81 kg) was given orally 250 mg of tetracycline hydrochloride every 8 hours for 2 weeks. From the literature, tetracycline hydrochloride is about 75% bioavailable and has an apparent volume of distribution of 1.5 L/kg. The elimination half-life is about 10 hours. The absorption rate constant is 0.9 hr^{-1}. From this information, calculate — **4**
(a) plasma drug concentration C_p at 4 hours after the 7th dose,
(b) average plasma drug concentration at steady-state C_{av}.
(c) maximum and minimum Concentration at steady state

5C. What are the role of different types of binders used in drug formulation process and give an example — **2**