5239 *Your Roll No*

B.Sc. Prog./III **J**

EL-310 (VIII) – Mathematical Methods
in Life Sciences

(NC – Admissions of 2005 & onwards)

Time   2 Hours *Maximum   Marks   38*

*(Write your Roll No on the top immediately
on receipt of this question paper)*

*Scientific   Calculator   is   allowed   Do   any   **one**
question from* **Unit I** *&* **Unit III** *and any* **two**
questions from **Unit II.**

UNIT I

1   (a) Show that the growth equation can be described
by the equation $N = N_0\, 2^{t/T}$ where N_0 is the initial
population and T is the half-life of the population

(b) A dated vial of sodium phosphate solution has a
labeld activity of 500 μC_i/ml How many milliliters
of this solution should be administered, exactly 10
das after the original assay to provide an activity
of 250 μC_i ? For ^{3}'P, $T_{1/2} = 14\,3$ days

(9½)
P T O

2   (a) In a population of 1000 cells which is in exponential growth with a mean generation time $T = 106$ min, a mutation arises for which the mean generation time is 53 min How long will it take the mutational cell type to overtake the original population ? What is the total population at that time ?

   (b) Assume that the limiting factor is the rate of fetal growth is nutrient flux, and that nutrients are supplied to the fetus across a surface corresponding to the vascular endothelium, the layer of cells lining the blood vessel Assume that this surface is directly proportional to the total surface area of the fetus itself, or equivalently to $w^{2/3}$, for $t > t^1$ Write down the differential equation for $w = w(t)$, and show that the solution can be expressed in the form of the empirical relation   (9½)

UNIT II

3   A Researcher was interested in knowing if preterm infants with late metabolic acidosi· and preterm infants without the condition differ with respect to urine levels of a certain chemical The mean levels, standard deviations and sample size for the two samples studied were as follows .

Sample	n	$\overline{x}$	S
With condition	35	8 5	5 5
Without condition	40	4 8	3 6

What should the researcher conclude on the basis of these results ? (Let $\dot{\alpha} = 05$)   (9½)

4 Complete the following ANOVA table and state which design was used

Source	SS	d f	MS	V R	P
Treatments		3			
Blocks	183 5	3			
Error	26 0				
Total	709 0	15			(9½)

5 Sixteen laboratory animals were fed a special diet from birth through age 12 weeks Their weight gain (in grams) is as follows

63	68	79	65	64	63	65	64
76	74	66	66	67	73	69	76

Can we conclude from this data that the diet results in a mean weight gain of less than 70 grams ? (Let $\alpha = 0\ 5$)   (9½)

P T. O

UNIT III

6   (a) Define Evens Sampling formula

     (b) What is the conditional distribution of the number
         of individuals with the two allele given that there
         was exactly one mutation   (9½)

7   Use Wright Fisher Model, if the parental allele has M
     haploid individuals and the prony allele has j lineages,
     assuming that M = 2N Calculate the mean and the
     variance of the frequency derived by the model
                                                          (9½)