

[This question paper contains 4 printed pages.]

Your Roll No.

5174

B

B.Sc. Prog./III

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

(Admissions of 2005 & onwards)

Time : 2 Hours

Maximum Marks : 38

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

Provide statistical table. Scientific Calculator is allowed.

All questions carry equal marks.

Do one question from Unit I and Unit III
and two questions from Unit II.

Unit I

1. (a) For some radioactive material in exponential decay show that :

$$K = - \frac{\log 2}{T_{1/2}} \quad 4$$

- (b) A dated vial of sodium phosphate solution has a labelled activity of 500 μ ci/ml. How many millilitre of this solution should be administered exactly 10 days after the original assay to provide an activity of 250 μ (i) for ^{32}P , $T_{1/2} = 14.3$ days. $5\frac{1}{2}$

[P. T. O.]

2. Assume that the concentration of an indicator $c(t)$ is fitted in the functional form $c(t) = c_0 (t - t_0)^{\nu} e^{-\lambda(t-t_0)}$, $t > t_0$. The observed value of the concentration at the times t_i , $i = 1, 2, \dots, n$ be denoted by $c^*(t_i)$, and t_0 is readily determined from the observation by inspection. Use the method of least square to find equations that determine the best value of the parameters c_0 , ν and λ . $9\frac{1}{2}$

Unit II

3. The face sheet of patients records maintained in a local health department contains 10 entries. A sample of 100 records revealed the following distribution of erroneous entries :

No. of erroneous entries out of 10	No. of records
0	8
1	25
2	32
3	24
4	10
5 or more	1

Test the goodness of fit of these data to the binomial distribution with $p = 0.20$. $9\frac{1}{2}$

4. The trained observers recorded the activity of 10 caged rats which had been handled regularly during the first 25 days of infancy and 8 rats which had not been handled regularly.

Activity Score

Handled rats	Unhandled rats
215	140
220	170
249	192
254	205
260	215
290	245
300	305
306	—
320	—

Do you think that the handled rats would be more active than unhandled rats? 9½

5. Complete the following ANOVA table and state which design was used :

Source	SS	<i>df</i>	MS	V.R
Treatments	5.05835	2	2.52917	1.0438
Error	65.42090	27	2.4230	

- (a) What design was employed?
- (b) How many treatments were compared?
- (c) How many observations were analysed?
- (d) At 0.05 level of significance can we conclude that the treatments have different effects? Why? $2+2+2+3\frac{1}{2}$

Unit III

6. Explain Hoppe's urn model and deduce that for fixed θ , as the sample size $n \rightarrow \infty$,

$$E(K_n) \sim \theta \ln n \text{ and } \text{Var}(K_n) \sim \theta \ln n. \quad 3+3+3\frac{1}{2}$$

7. Explain Ewen's sampling formula and deduce that if $\bar{a}_1 = a_1 - 1$, a new colour was just added, then the ratio of the probabilities in the event sampling formula is :

$$\frac{P_\theta(a)}{P_\theta(\bar{a})} = \frac{n}{\theta + n - 1} \cdot \frac{\theta}{a_1}. \quad 5+4\frac{1}{2}$$