

[This question paper contains 4 printed pages.]

4671

Your Roll No.

B.Sc. Prog./III

AS

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.)*

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

All questions carry equal marks.

UNIT I

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

$$K = -\frac{\text{Log } 2}{T_{1/2}}$$

where $T_{1/2}$ is the half-life.

- (b) Hill's empirical relationship between the load being raised by a muscle and the Speed V with which the muscle shortens is given as

P.T.O.

$$(P + a) V = (P_0 - P)b$$

where a , b and P_0 are constants characteristic of the grin muscle. How should the data from an experiment be plotted so as to permit an easy determination of the constants a and b , assuming P_0 was known from an independent experiment?

2. Discuss the host-parasite problem by finding dy/dx and sketching the trajectories in the xy plane.

(a) For the case when :

(i) the birth rate equals the death rate in the host population

(ii) none of the parasites' eggs hatch

- (b) Investigate the solution in the neighbourhood of $x = y = 0$. Is the equilibrium state stable or unstable?

UNIT II

3. Analyse and complete the following ANOVA Table

Sources	SS	df	MS	V.R.
Among Samples	14649.1514	3		
Within Samples		57		
Total	37860.0547			

4. HIV - infected women who are also infected with human papillomavirus (HPV) detected by molecular hybridization, are more likely to have cervical cytologic abnormalities than are women with only one or neither virus. The following data was collected by the investigators. Is there a relationship between HPV status and stage of HIV infection.

HPV Status and Stage of HIV Infection Among 96 Women

HPV	HIV			Total
	Seropositive symptomatic	Seropositive asymptomatic	Seronegative	
Positive	23	4	10	37
Negative	10	14	35	59
Total	33	18	45	96

5. Obtain the multiple regression equation of the following data collected by a hospital administrator on 7 communities in the hospital's catchment area :

Community	Persons per 1000 population admitted during study period	Index of availability of other health services	Index of indigency
1	61.6	6.0	6.3
2	53.2	4.4	5.5
3	65.5	9.1	3.6
4	64.9	8.1	5.8
5	72.7	9.7	6.8
6	52.2	4.8	7.9
7	50.2	7.6	4.2

UNIT III

6. Explain Hoppe's urn model. Compute the expected value of η , where η is the ball added in Hoppe's urn.
7. (a) Define Ewens sampling formula.
(b) What is the conditional distribution of the number of individuals with two alleles given that there was exactly one mutation?