ENGINEERING MATHEMATICS AND BIOSTATISTICS
(BIOT 5104)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
__any 5 (five)__ from Group B to E, taking __at least one__ from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i)   Let A and B be two matrices. Then $(AB)^T =$
          (a) $A^T B^T$ (b) $A^T + B^T$
          (c) $A^T - B^T$ (d) none of these.

   (ii) $\int_{-4}^{4}(x^7 + x^9)\,dx =$
          (a) 4   (b) 8
          (c) 0   (d) none of these.

   (iii) Range-Kutta method is used to solve
          (a) a system of linear equation   (b) algebraic equations
          (c) ordinary differential equations   (d) partial differential equations.

   (iv)   .... refer to the lack of symmetry of a distribution
          (a) Mean   (b) SD   (c) Skewness   (d) median.

   (v)   Variables whose values cannot be expressed numerically are called
          (a) quantitative   (b) qualitative
          (c) continuous   (d) absolute.

   (vi)   The.............. is the average evaluated after applying weights to the item as judged by their relative importance.
          (a) weighted arithmetic   (b) median
          (c) mode   (d) standard deviation.

   (vii) .... is the measure of the peakedness of the probability distribution of a real-valued random variable.
          (a) Mean   (b) Kurtosis
          (c) Skewness   (d) Median.

   (viii) The sum of the squared deviations of the observations from the mean is
          (a) minimum   (b) large
          (c) maximum   (d) zero.

   (ix)   Chi square test measures the
          (a) degree of deviation of observed result from expected
          (b) closeness of observed and expected frequency
          (c) population variance and sample variance
          (d) all of the above.

   (x)   The event that deals with consecutive trials, each of which has two possible outcomes is called
          (a) binomial distribution   (b) probability distribution
          (c) bernoulli process   (d) random distribution.

Group – B

2. (a)   Find the adjoint and the reverse of the matrix
         $\begin{bmatrix} 3 & 2 & 1 \\ 1 & 1 & 1 \\ 5 & 1 & -1 \end{bmatrix}$
         Also verify that $AA^{-1} = I$

   (b)   Given dy/dx = y – x/y +x with initial condition y = 1 at x = 0, find y for x = 0.1 by Euler's method, correct upto 4 decimal places, taking step length h = 0.02.

                                                          6 + 6 = 12

3. (a)   Prove that every square matrix can be expressed as a sum of a symmetric matrix and a skew-symmetric matrix.
         Prove that the product of two orthogonal matrices is orthogonal.

   (b)   Find $lim_{x \to 0} \frac{xe^x - log_e(1-x)}{x^2}$. Show your calculations.

                                                          6 + 6 = 12

Group – C

4. (a)   Following data relate to increase in dry weight of the pods of a plant after a particular treatment. Calculate the mean, standard deviation and standard error from the following distribution.

Observation	1	2	3	4	5	6	7	8	9	10
Increase in dry weight	4.25	4.20	4.15	3.35	3.25	4.70	3.25	3.75	3.70	3.90

(b) Ten patients with high blood pressure participated in a study to evaluate the effectiveness of the drug 'X' in reducing their blood pressure. The accompanying table gives blood pressure measurements taken before and after two weeks of treatment with 'X'. Calculate the value of SD of the change in blood pressure.

Patient	BP-Before	BP-After
1	172	159
2	186	157
3	170	163
4	205	207
5	174	164
6	184	141
7	178	182
8	156	171
9	190	177
10	168	138

(c) Two hundred families with three children in a population from Arambagh subdivision are sampled at random. How many families do we expect to have
(i) no girls, (ii) one girl, (iii) two girls? Assume sex ratio to be 1:1.

4 + 4 + 4 = 12

5. (a) How many mammalian cells would be killed if an irradiation dose administrated to a cell population was sufficient for an average of 5 lethal hits per target, when in fact only 2 hits are needed for lethality? (given e^{-5} = 0.0067)

(b) Compute the median and mode of the following distribution of tracheal ventilation scores (ml per minute) of a sample of beetle.

Class interval	61-65	66-70	71-75	76-80	81-85
Frequencies	12	25	45	30	8

6 + 6 = 12

Group – D

6. (a) A sample of 400 items is taken from a normal population whose mean is 4 and whose variance is also 4. If the sample mean is 4.45, can the sample mean be regarded as truly random sample? Given that Z_α at p 0.05 is 1.96.

(b) Two samples were drawn from two normal populations of two districts and their values are

A	66	67	82	75	76	90	92	88	84		
B	66	64	78	74	87	85	82	95	93	97	92

Test whether the two populations have the same variance at 5% level of significance. Given that table value of F at 0.05 for df 10 and 8 is 3.35.

6 + 6 = 12

7. (a) Two curly winged flies when mated, produce 61 curly and 35 straight winged progeny. Use a chi-square test to determine whether these numbers fit a 3:1 ratio. Given that $x^2_{0.05}$ for df 1 at 0.05 = 3.84.

(b) Test whether the prevalence of filarial is associated with sex.

Sex	No. of carriers	No. of non-carriers	Total studied
Male	78	412	490
Female	57	553	610

Given that $x^2_{0.05}$ at df 1= 3.84.

6 + 6 = 12

Group – E

8. (a) The coefficient rank correlation between marks of A and B obtained by a certain group of P.G. students of a college is 2/3 and the sum of the square of the difference in rank is 55. Find the number of students in the group.

(b) Find out the Pearson's correlation coefficient between shell height and shell breadth of the snails.

Serial no.	1	2	3	4	5	6	7	8	9
Shell height (in mm)	9.1	9.2	9.5	9.7	5.8	6.9	7.0	5.5	9.3
Shell breadth (in mm)	2.5	3.0	3.6	3.5	2.4	2.7	3.0	2.3	4.0

6 + 6 = 12

9. (a) The following results were worked out from the scores in Subject A and Subject B in one semester exam.

	Score in A	Score in B
Mean	39.5	47.5
Standard Deviation	10.8	17.8

Correlation coefficient is 0.42. Find both regression lines. Estimate the marks obtained by a student in A who scored 50 in B.

(b) The following data give the yields on 12 plots of land having equal area using three varieties of fertilizers A, B & C.

A	B	C
25	20	24
22	17	26
24	16	30
21	19	20

Is there any significant difference in the average yields of land under the three varieties of fertilizers? Given that F at df (2, 9) at 5% level = 4.26.

6 + 6 = 12