

M.TECH/BT/1ST SEM/BIOT 5104/2017
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) If λ is an Eigen value of a non-singular matrix A , then $\frac{1}{\lambda}$ is an Eigen value of
 (a) $A - I$ (b) A^T (c) A^2 (d) A^{-1} .
- (ii) Runge-Kutta method is used for solving
 (a) an algebraic equation
 (b) a first order ordinary differential equation
 (c) a first order partial differential equation
 (d) integral equation.
- (iii) _____ is the number of values in the final calculation of a statistic that are free to vary
 (a) Null hypothesis (b) Alternate hypothesis
 (c) Degrees of freedom (d) F statistic.
- (iv) The most frequently occurring value of a data set is called the
 (a) range (b) mode
 (c) mean (d) median.
- (v) Variables whose values cannot be expressed numerically are called
 (a) quantitative (b) qualitative
 (c) continuous (d) absolute.

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- (vi) If a data set has an even number of observations, the median
 (a) cannot be determined
 (b) is the average value of the two middle items
 (c) must be equal to the mean
 (d) is the average value of the two middle items when all items are arranged in ascending order.
- (vii) The difference between the largest and the smallest data values is the
 (a) variance (b) interquartile range
 (c) range (d) coefficient of variation.
- (viii) To determine the variation in wing length of butterfly from 5 different places, which would be the best statistical test?
 (a) F test (b) Student's t test
 (c) Chi-square (d) Regression analysis.
- (ix) The statistical test used to validate the statement 'people having high cholesterol suffer more from hypertension'
 (a) Student's t test (b) Person correlation
 (c) Chi-square (d) ANOVA.
- (x) Chi square is zero when
 (a) expected frequency is less than observed frequency
 (b) expected frequency is equal to observed frequency
 (c) expected frequency is double of observed frequency
 (d) expected frequency is greater than observed frequency.

Group - B

2. (a) Determine the values of α, β, γ for which the matrix
- $$A = \begin{bmatrix} 0 & 2\beta & \gamma \\ \alpha & \beta & -\gamma \\ \alpha & -\beta & \gamma \end{bmatrix}$$
- is orthogonal.
- (b) Find the solution of the differential equation $\frac{dy}{dx} = x^2 - y$, $y(0) = 1$ for $x = 0.3$, ($h = 0.1$) using Euler's method.

6 + 6 = 12

3. (a) Solve $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = x^2e^{3x}$.
- (b) If $y = \log(u^2 + 1)$, $u = \sin x$ find $\frac{dy}{dx}$.
- (c) If $v = \sin^2 u$ where $u = x^3y^4$, find $\frac{\partial v}{\partial y}$.

6 + 3 + 3 = 12

Group - C

4. (a) In how many ways 6 calendula plants and 4 rose plants be grown in a field in a straight line so that no two rose plants are placed together?
- (b) The mean weight of 50 and 100 crabs are 54.4 gram and 50.3 gram respectively and the standard deviations are 8 and 7. Obtain the mean and standard deviation of the sample of 150 (100 + 50) obtained by combining the two samples.
- (c) Consider a family with two children in a locality where both parents are heterozygous for albinism. What proportion of these families would be expected to have
- neither child with albinism
 - one child with albinism
 - both children with albinism?

2 + 4 + 6 = 12

5. (a) In a medical college they receive patient at the rate of 3 patients per minute on average. What is the probability of receiving no patients in one minute interval? [given $e = 2.718$]
- (b) A subject question paper contains 10 questions which are divided into two groups each containing 5 questions. A student is asked to answer 6 questions only, asked to choose at least 2 questions from each group. In how many different ways can the student make up his or her choice?

6 + 6 = 12

Group - D

6. (a) An IQ test was administered to 5 persons before and after they are trained. The results are given below:

Candidates	I	II	III	IV	V
Before training	110	120	123	132	125
After training	120	118	125	136	121

Test whether there is any change in IQ after training programme. Given that $t_{0.01} = 4.6$ for $df 4$.

- (b) Body length of fishes of a species was obtained from two ponds. They were measured as follows:

Pond A	20	24	20	28	22	20	24	32	24	26
Pond B	12	10	8	10	6	4	14	20	10	6

Calculate the mean difference in total body length between the two ponds of fish is significant or not. Given that $t_{0.05}$ at $df 18 = 2.10$.

6 + 6 = 12

7. (a) In the evening primrose pure red flowered plants were crossed with white flowered plants, F_1 are all pink coloured. Inbred F_1 plants produced 113 red, 242 pink and 129 white flowered plants. This phenotypic ratio also seems to be genotypic ratio of the F_2 of a Mendelian monohybrid cross involving a gene responsible for flower pigmentation. Analyse the result with suitable statistical test. Given that χ^2 value for 2 df at 0.05 is 5.99.

- (b) The following table gives the classification of 100 workers according to sex and nature of work. Justify whether nature of work is independent of the sex of the worker.

	Skilled	Unskilled
Male	40	20
Female	10	30

Critical value of χ^2 at 0.05 for $df 1$ at 0.05 is 3.84.

6 + 6 = 12

Group - E

8. (a) You are given the following results of two variable A and Y:

$$\bar{A} = 36 \quad \bar{Y} = 85 \quad \sigma_a = 11 \quad \sigma_y = 8 \quad r(A,Y) = 0.66.$$

Find the two regression equations and estimate the values of A and Y = 75.

- (b) Find the correlation coefficient between the heights of fathers and daughters both from the following members.

Height of father (in cm)	64	65	66	67	68	69	71
Height of daughters (in cm)	66	67	68	69	70	71	72

6 + 6 = 12

9. (a) The varieties of A, B, C wheat were sown in 4 plots each and the following yields in quintal per acre of land were obtained:

A	B	C
8	7	2
4	5	5
6	5	4
7	3	4

Test the significance of difference between the yields of the varieties. Given that 5% tabulated value of F at *df* 2 and 9 is 4.26.

- (b) The following results were obtained from records of age (X) and systolic blood pressure (Y) of a group of 10 teachers in a college:

Variables	Age (X)	Blood pressure (Y)
Mean	5.3	142
Variance	130	165

$$= \sum(Y - \bar{Y})(A - \bar{A}) = 1220$$

Find the appropriate regression equation and estimate the blood pressure of a teacher whose age is 50 years.

6 + 6 = 12