ENGINEERING MATHEMATICS AND BIOSTATISTICS
(BIOT 6121)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) 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.

(ii) The value of k for which the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 5 & 3 & 4 \\ 6 & k & 4 \end{bmatrix}$ is singular is
(a) 2 (b) 1 (c) 4 (d) 3.

(iii) Performing an event once is called
(a) Sample (b) Trial (c) Error (d) None of the above.

(iv) The mean of x+2, x+3, x+4 and x-2 is
(a) (x+7)/4 (b) (2x+7)/4
(c) (3x+7)/4 (d) (4x+7)/4

(v) The median of the data: 4, 6, 8, 9, 11 is
(a) 6 (b) 8 (c) 9 (d) 11

(vi) The degrees of freedom for a Chi Square distribution with 18 samples will be
(a) 17 (b) 18 (c) 19 (d) 20

(vii) Z-score is calculated for
(a) Chi-square distribution (b) T-distribution
(c) Standard normal distribution (d) Normal distribution.

(viii) When the correlation coefficient, r, is close to one:
(a) there is no relationship between the two variables
(b) there is a strong linear relationship between the two variables
(c) it is impossible to tell if there is a relationship between the two variables
(d) the slope of the regression line will be close to one.

(ix) What's the probability of drawing a red card or a card with a face (king, queen, or jack) from a standard deck of 52 cards?
(a) 13/52 (b) 21/52 (c) 29/52 (d) 8/13.

(x) Analysis of Variance is a statistical method of comparing the _____ of several populations.
(a) mean (b) variance
(c) standard deviation (d) none of the above

Fill in the blanks with the correct word

(xi) A square matrix A is said to be symmetric if _____.

(xii) If $A = \begin{pmatrix} 1 & 4 \\ 3 & 2 \end{pmatrix}$, then eigen values of A^{-1} are_____.

(xiii) When the p-value is less than the significance level, the Null hypothesis is _____.

(xiv) The mean of the square deviation about mean is known as _____.

(xv) When 'n' is a middle value then median is defined as _____ .

Group - B

2. (a) State Cayley-Hamilton theorem and verify the theorem for the matrix $A = \begin{bmatrix} 1 & 2 & 1 \\ 1 & -1 & 1 \\ 2 & 3 & -1 \end{bmatrix}$. *[(BIOT6121.1)(Remember/LOCQ)]*

(b) Given $\frac{dy}{dx} = \frac{y-x}{y+x}$ with initial condition $y = 1$, at $x = 0$; find the approximate value of y for $x = 0.1$ by Euler's method taking $h = 0.02$. *[(BIOT6121.1)(Apply/IOCQ)]*

6 + 6 = 12

3. (a) Apply Runge-Kutta method of fourth order to find the approximate value of $y$at $x = 0.2$ given, $\frac{dy}{dx} = x + y, y(0) = 1$ taking $h = 0.1$. *[(BIOT6121.1)(Apply/IOCQ)]*

(b) Solve the linear differential equation $\frac{dy}{dx} + 2xy = e^{-x^2}$. *[(BIOT6121.1)(Understand/IOCQ)]*

6 + 6 = 12

Group - C

4. (a) In a research laboratory, radioactive emission occurs average one particle per minute. If emission continues for several hundred minutes during which time the particles are emitted randomly, in what proportion of these minutes would we expect the following? (Given e-m=0.36788)
(i) Exactly one particle emitted
(ii) Exactly three particles per minute
(iii) More than three particles per minute. *[(CO2)(Evaluate/HOCQ)]*

(b) A couple is heterozygous for albinism (Aa) What is the probability that (i) 4 out of 6 children born to them are normal? (ii) 4 normal and 2 albino out of 6children. *[(CO2)(Analyze/IOCQ)]*

6 + 6 = 12

5. (a) 12% of the items produced by a machine are defective. What is the probability that out of a random sample of 20 items produced by a machine 5 are defective.

[(CO3)(Justify/IOCQ)]

(b) The following table gives the age distribution of patients of a certain disease reported in a hospital during a particular year. Find the mean and median.

Age grp	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-50
No. of patients	2	11	26	17		6	3	2	1

[(CO3)(Understand/LOCQ)]

(c) The probability that a student passes a test on B subject is 2/3 and the probability that he passes both B and X is 14/45. The probability that he passes at least one test is 4/5. What is the probability that the student passes the X test?

[(CO3)(Analyze/IOCQ)]

4 + 4 + 4 = 12

Group - D

6. (a) Ten students were given intensive coaching is statistics. The scores obtained in 1st and 2nd test are given below.

Sl no.	1	2	3	4	5	6	7	8	9	10
Marks in 1st	50	52	53	60	65	67	48	69	72	80
Marks in 2nd	65	55	65	65	60	67	49	82	74	86

Does the score from 1st test to 2nd test show an improvement? Given that $t_{0.05, 9}$ = 1.833. *[(CO4)(Analyze/IOCQ)]*

(b) In order to find the effect of Azolla growth on the rice field and experimentally grown Azolla in 10 similar field plots before rice planting and other 10 similar plots were taken as control without Azolla growth. Rice was grown in all these plots and yields were noted.

Plot no.	1	2	3	4	5	6	7	8	9	10
With Azolla	15.3	15.8	16.1	17.0	15.5	16.5	16.2	15.5	17.1	16.3
Without Azolla	14.5	13.8	15.9	13.9	14.8	14.9	15.2	15.0	14.1	13.7

Verify whether there is any significant effect of Azolla growth on the gain of yield of rice. Given that $t_{0.05, 18}$ = 2.10. *[(CO3)(Evaluate/HOCQ)]*

6 + 6 = 12

7. (a) In Laboratory researchers had repeated some of Mendel's experiments. For example, the following F_2 results were shown with seed shape in pea plants: Wrinkled 884 and Round 288. Calculate the goodness of fit for these data. Given that: value of chi-square at 0.05 for *df* 1 is 3.84. *[(CO4)(Evaluate/HOCQ)]*

(b) Applications of fertilizers were tested for the yield of rice grown in 10 plots. Another seed of 10 plots of similar size & condition were taken as control. Test the effect of fertilizer.

Plot no.	1	2	3	4	5	6	7	8	9	10
Fertilizer applied	16	14	18	15	13	17	16	15	14	13
Fertilizer not applied	10	12	11	9	13	13	12	14	13	11

Given that critical value of *t* at 0.05 for *df* 18 is 2.10. *[(CO3)(Calculate/HOCQ)]*

6 + 6 = 12

Group - E

8. (a) Define ANOVA. *[(CO3)(Analyse/HOCQ)]*

(b) 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* 2and 9 is 4.26. *[(CO4)(Calculate/HOCQ)]*

2 + 10 = 12

9. (a) In a study of the effect of dietary component on plasama lipid composition, the following ratios were obtained on a sample of experimental animals.

Measure of dietary component [X]	Measure of plasma lipid profile[Y]	Measure of dietary component [X]	Measure of plasma lipid profile[Y]
1	6	1	1
5	1	1	2
3	0	7	1
2	0	3	5

Obtain the correlation coefficient and comment. *[(CO4)(Evaluate/HOCQ)]*

(b) For 10 observations on price (x)and supply (y), the following data were obtained (in appropriate units):

$\sum x=130$, $\sum y=220$, $\sum x2=2238$, $\sum y2=5506$, $\sum xy=3467$

Obtain the line of regression of y on x and estimate the supply when the price is 16 units. *[(CO4)(Calculate/IOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	10.41	45.83	43.75