ENGINEERING MATHEMATICS AND BIOSTATISTICS
(BIOT 6121)

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

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^5 x \, dx =$

        (a) 1   (b) –1   (c) $\frac{\pi}{2}$ (d) 0.

    (ii) $\int_{0}^{\frac{\pi}{2}} (a^2 \cos^2 x + b^2 \sin^2 x) dx =$

        (a) $\frac{\pi}{4}(a^2 + b^2)$ (b) $\frac{\pi}{2}(a^2 + b^2)$

        (c) $\frac{1}{4}(a^2 + b^2)$ (d) $\frac{\pi}{4}$.

    (iii) Cofactor of x in the determinant $\begin{vmatrix} 1 & 2 & -1 \\ 0 & 1 & x \\ 1 & -1 & 3 \end{vmatrix}$ is

        (a) 3   (b) 0   (c) 2   (d) –1.

    (iv) .... is a collection of statistical models used to analyze the differences among group means and their associated procedures
        (a) Anova   (b) Ttest   (c) Chi-square analysis   (d) F test.

    (v)   Standard deviation is the square of
        (a) Mode   (b) Standard error   (c) Regression   (d) Variance.

(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) The sum of the squared deviations of the observations from the mean is
(a) Minimum   (b) Large   (c) Maximum   (d) Zero.

(viii) If P[A] =1. Then the event A is said to be a
(a) sure event   (b) null event
(c) independent event   (d) impossible event.

(ix) 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.

(x) The event that deals with consecutive trials, each of which has two possible outcomes
(a) Binomial distribution
(b) Probability distribution
(c) Bernoulli process
(d) Random distribution

Group – B

2. (a) If $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & -1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, then verify that A satisfies its own characteristic equation. Hence find the inverse of the above matrix.

(b) Find the rank of $\begin{bmatrix} 2 & -4 & 3 & 1 & 0 \\ 1 & -2 & 1 & -4 & 2 \\ 0 & 1 & -1 & 3 & 1 \\ 4 & -7 & 4 & -4 & 5 \end{bmatrix}$.

6 + 6 = 12

3. (a) Compute $y(0.2)$ from the equation $\dfrac{dy}{dx} = x - y$, taking h=0.1 by Runge-Kutta method of order four, correct to four decimal places.

(b) Solve $\dfrac{d^2 y}{dx^2} + 4\dfrac{dy}{dx} + 4y = e^{3x} + \sin 5x$.

6 + 6 = 12

(b) The following data give the yields on 12 plots of land in three samples under three varieties of fertilizers.

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

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:

(b) Ten patients with high blood pressure participated in a study to evaluate the e

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

eatment 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 a village 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) 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 I) neither child with albinism, II) one child with albinism, III) both children with albinism?

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 $t_{0.05}$ = 4.6 for df 4.

(b) Body length of fishes of a species was obtained from two ponds. They were measured in cm 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, F1 are all pink coloured. Inbred F1 plants produced 113 red, 242 pink and 129 white flowered plants. This phenotypic ratio also seems to be genotypic ratio of the F2 of a Mendelian monohybrid cross involving a gene responsible for flower pigmentation. Analyse the result with suitable statistical test. Given that x^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 x^2 at 0.05 for df 1 at 0.05 is 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 B
Mean	39.5	47.5
Standard Deviation	10.8	17.8

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