

**ENGINEERING MATHEMATICS & 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
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) 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) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^5 x dx =$
(a) 0 (b) 1
(c) $\frac{1}{3}$ (d) $\frac{1}{6}$.
- (iii) Which of the following is parametric test?
(a) ANOVA (b) Student's t-test
(c) Wilcoxon rank test (d) Krushkal-Wallis test
- (iv) Chi-square test is always used to test
(a) Population mean (b) Test of association
(c) Population median (d) None of the above
- (v) The minimum df for the chi-square test is always
(a) 0 (b) 1
(c) 2 (d) N-1
- (vi) P-value is the probability of the calculated value, if p-value is zero then we reject H_0 after comparing with
(a) Level of significance (b) df
(c) critical value (d) sample size

- (vii) Z-score is calculated for
 (a) chi-square distribution (b) t-distribution
 (c) standard normal distribution (d) normal distribution
- (viii) Find the number of ways of arranging the letters of the words DANGER, so that no vowel occupies odd place.
 (a) 36 (b) 48
 (c) 144 (d) 96
- (ix) If 'X' is a random variable, taking values 'x', probability of success and failure being 'p' and 'q' respectively and 'n' trials being conducted, then what is the probability that 'X' takes values 'x'? Use Binomial Distribution
 (a) $P(X = x) = {}^n C_x p^x q^x$ (b) $P(X = x) = {}^n C_x p^x q^{(n-x)}$
 (c) $P(X = x) = {}^x C_n q^x p^{(n-x)}$ (d) $P(x = x) = {}^x C_n p^n q^x$
- (x) Let A and B be two events such that $P(A) = 1/5$ While $P(A \text{ or } B) = 1/2$. Let $P(B) = P$. For what values of P are A and B independent?
 (a) $1/10$ and $3/10$ (b) $3/10$ and $4/5$
 (c) $3/8$ only (d) $3/10$

Group- B

2. (a). Find the Eigen values and corresponding any two Eigen vectors of the matrix

$$A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$$
 [(CO1) (Remember/LOCQ)]
- (b) Show that the equation $(y^2 e^{xy^2} + 4x^3)dx + (2xye^{xy^2} - 3y^2)dy = 0$ is exact and hence find the solution. [(CO1) Apply/IOCQ]
6 + 6 = 12
3. (a) Solve $(x - \log y) \frac{dy}{dx} + y \log y = 0$. [(CO1) (Apply/IOCQ)]
- (b) Evaluate $y(1.2)$ using Runge-Kutta method of order 4 of the initial value problem $\frac{dy}{dx} = x^2 + y^2, y(1) = 0$. [(CO1)(Evaluate/HOCQ)]
6 + 6 = 12

Group - C

4. (a) The average number of customers , who appear at a counter of a red cross blood bank per minute is two. Find the probability that during a given minute (Given $e^{-2}=0.1353$). [(CO3) (Justify/IOCQ)]
- (b) Ten students are seated at random in a row. Find the probability that two particular students are not seated side by side. [(CO2) (Analyze/IOCQ)]
- (c) The following table gives the weekly expenditure of 100 families. Find the median weekly expenditure.

Weekly expenditure(Rs)	Number of families
0-100	14
100-200	23
200-300	27
300-400	21
400-500	15

[[CO1](Remember/LOCQ)]

4 + 4 + 4 = 12

5. (a) A committee of three is to be chosen from a group consisting of 4 men and 5 women. If the selection is made at random, find the probability that a) all three are men, b) two are men. [[CO2] (Calculate/HOCQ)]

- (b) Daily high blood pressure of patient on 100 days is given below

B.P.(mmHg):	102	106	110	114	118	122	126
No of days	3	9	25	35	17	10	1

Calculate the mean and standard deviation of the above data.

[[CO4] (Understand/LOCQ)]

6 + 6 = 12

Group - D

6. (a) Ten students were given intensive coaching in 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 1 st	50	52	53	60	65	67	48	69	72	80
Marks in 2 nd	65	55	65	65	60	67	49	82	74	86

Does the score from 1st test to 2nd test show an improvement? Given that $t_{0.05, 9} = 2.26$

[[CO4] (Remember/LOCQ)]

- (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 $t_{0.05, 18} = 2.10$. [[CO4] (Analyze/IOCQ)]

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 χ^2 value for 2 *df* at 0.05 is 5.99. [(CO3) (Analyze/IOCQ)]

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

Sex	Skilled	Unskilled
Male	40	20
Female	10	30

Given that $\chi^2_{0.05}$ at *df* 1 = 3.84.

[(CO3) (Analyze/IOCQ)]

6 + 6 = 12

Group - E

8. (a) Calculate the correlation coefficient between the price and consumption of the following data:

Price	15	18	21	24	27	30	33
consumption	10	10	8	7	7	6	6

[(CO4) (Remember/LOCQ)]

- (b) From the data given below estimate the height of father whose son's height is 70". Father: mean height is 67" and SD is 3.5", Son: mean height is 65" and SD is 2.5". [(CO4)(Analyze/IOCQ)]

6 + 6 = 12

9. (a) Students of a particular class got the following percentage of marks in two subjects A and B.

A	8	36	98	25	75	82	92	62	65	35
B	84	51	91	60	68	62	86	58	35	49

Find out the spearman's rank correlation coefficient and comment on it.

[(CO4) (Apply/IOCQ)]

- (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	14
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.

[(CO4) (Calculate/HOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	35.5%	45.8%	18.7%

Course Outcome (CO):

After completing the course, the students will be able to:

1. Understand the basic principles of linear algebra, concept of function, limit, continuity and normal distribution.
2. Comprehend and use the different statistical models of dispersion and probability dispersion.
3. Apply the mathematical and biostatistical models in biological systems for testing of hypotheses, estimation of group differences and case-control studies..
4. Interpret the concept of correlation and regression analysis of variables along with analysis of variance.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
BT	https://classroom.google.com/c/NDE3OTE0Nzc4ODYw/a/NDY0MTYxNDIzNDk2/details