

**HERITAGE INSTITUTE OF TECHNOLOGY**1st year 1st Semester Examination. 2014

Session : 2014-2015

Discipline : BIOTECHNOLOGY

Paper Code : BIOT5104 Paper Name : Engineering Mathematics and Biostatistics

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 x 1=10
- (i) The _____ is used to calculate to what extent data vary from the mean or from any other statistics.
- (a) Mean (b) Median
(c) Measure of dispersion (d) Variance
- (ii) _____ refers to the lack of symmetry of a distribution.
- (a) Central tendency (b) Dispersion
(c) Skewness (d) Kurtosis
- (iii) When the value of the kurtosis is 2, then it has to be _____
- (a) Mesokurtic (b) Leptokurtic
(c) Platykurtic (d) None of the above
- (iv) For an impossible event A, P(A) will be
- (a) -1 (b) 0
(c) ½ (d) 1
- (v) The sum of the Eigen values of the matrix $A = \begin{bmatrix} a & h & g \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$ is
- (a) a + h + g (b) h + b
(c) a + b + c (d) a + h + g + b + c
- (vi) If λ is an Eigen value of matrix A, then the Eigen value of A^T (transpose of A) is
- (a) λ^{-1} (b) λ
(c) $\lambda-1$ (d) $\lambda+1$
- (vii) The rank of the matrix A is $= \begin{bmatrix} 2 & -4 & 6 \\ -1 & 2 & -3 \\ 3 & -6 & 9 \end{bmatrix}$
- (a) 3 (b) 2
(c) 0 (d) 1

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- (viii) For which of the following distributions, the support (or range) of the underlying random variable is $(0, \infty)$?
- (a) Poisson (b) Normal
(c) t (d) F
- (ix) Normal distribution is a probability distribution which is
- (a) Symmetric (b) positively skewed
(c) negatively skewed (d) leptokurtic
- (x) If $2x + 3y = 1$, the correlation coefficient between x and y is
- (a) -1 (b) 0 (c) $\frac{1}{2}$ (d) 1

Group – B

2. (a) Calculate maxima and minima of $3x^4 - 2x^3 - 6x^2 + 6x + 1$ within 0 and 2.
- (b) Using any one numerical method, solve the following equations:

$$x + y + z = 9; \quad 2x - 3y + 4z = 13; \quad 3x + 4y + 5z = 40.$$

$$4 + 4 + 4 \\ = 12$$

- (c) Calculate $\int_0^{\frac{\pi}{2}} \sin^4 x \cos^2 x \, dx$.
3. (a) Calculate the area under the curve $ay^2 = x^3$, x axis and $x = a$.
- (b) Solve the differential equation: $xy \frac{dy}{dx} = 1 + x + y + xy$.
- (c) The rate at which bacteria multiply is proportional to the instantaneous number present. If the original number doubles in 2 h, how many hr. will it take to triple?

$$4 + 4 + 4 \\ = 12$$

Group – C

4. (a) What is the probability of having (i) three boys and one girl in a family of four children, or (ii) three girls and one boy in a family of four children? Apply Binomial distribution.



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(b) The lengths of Microfilaria in the pleural blood were each measured to the micro are given:

Length	Frequency	Length	Frequency
35-39	2	60-64	35
40-44	3	65-69	113
45-49	10	70-74	167
50-54	1	75-79	112
55-59	1	80-84	10

Calculate Mean, Median, and Standard deviation.

6 + 6 = 12

5. (a) In a population having two hundred families with three children in each, how many families do we expect to have (i) no girl child, (ii) one girl child (ii) two girl children? Assume the sex ratio to be 1:1.

(b) Genetics question paper contains 12 questions divided into three parts – Part A contains 6 questions, Part B and Part C contains 3 questions each. A candidate is required to attempt 6 questions selecting at least 3 questions from Part A and at least one from each of the parts B and C. In how many ways can the candidate select these 6 questions?

5 + 7 = 12

Group - D

6. (a) What do you mean by paired and unpaired t test?

(b) In a cross between black and white coat coloured mice, the F2 individuals segregated into 787 black and 277 white coat coloured individuals. Test whether these results agree with the expected ratio of 3:1. Apply chi-square test with P = 0.05. Critical value of χ^2 for df = 1 is 3.84.

(c) Ten students were given intensive coaching in statistics. The scores obtained in 1st and 5th test are given below.

Marks in 1 st	50	52	53	60	65	67	48	69	72	80
Marks in 5 th	65	55	65	65	60	67	49	82	74	86

Does the score from 1st test to 5th test show an improvement? Critical value of t at 0.05 for 9 df is 1.833

2 + 5 + 5 = 12

7. (a) What do you mean by Null Hypothesis? What is Type-I error in connection with testing of hypotheses? What is power of a test?



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(b) The mean I.Q. of a sample of 1600 children was 99. Is it likely that this was a random sample from a population with mean I.Q. 100 and standard deviation 15? Critical value of $Z_{0.05}$ is 1.96.

(2+2+2) +
6 =12

Group – E

8. Students got the following percentage of marks in Mathematics (X) and Statistics (Y). Find the correlation coefficient between X and Y. Also derive the regression line of X on Y.

Maths(X)	08	36	98	25	75	82	92	62	65	35
Statistics(Y)	84	51	91	60	68	62	86	58	35	49

(6 + 6) =
12

9. (a) 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 is 3.84.

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

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