



Question Paper Code: 20007

B.E. / B.Tech. DEGREE END SEMESTER EXAMINATIONS – JAN. 2026

Fourth Semester

Biotechnology

U19MA408 – PROBABILITY AND STATISTICS

(Common to BME)

(Regulation 2019)

Time : Three Hours

Maximum : 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

STATISTICAL TABLES MAY BE PERMITTED

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Define Random Variable.	2	K2	CO1
2.	Given that the pdf of a RV X, is $f(x) = Kx, 0 < x < 1$, Find K.	2	K2	CO1
3.	Define Poisson distribution.	2	K2	CO2
4.	The mean of a Binomial distribution is 20 and S.D. is 4. Determine the parameters of the distribution.	2	K1	CO2
5.	Write any two properties of correlation coefficient.	2	K2	CO3
6.	Find the angle between two lines of regression?	2	K1	CO3
7.	What is meant by Interval Estimation?	2	K1	CO4
8.	If 'T' is an unbiased estimator for θ , then show that 'T ² ' is a biased estimator of θ^2 .	2	K2	CO4
9.	What are Type – I and Type – II errors?	2	K1	CO5
10.	Give the main application of χ^2 test.	2	K2	CO5

PART – B

(5x 16 = 80 Marks)

Q.No.	Questions	Marks	KL	CO
11. a)	A random variable X has the following probability distribution	16	K3	CO1

$X = x$	-2	-1	0	1	2	3
$P(x)$:	0.1	k	0.2	2k	0.3	3k

- Find the value of k.
- Evaluate $P(X < 2), P(-2 < X < 2)$.
- Find the cumulative distribution function of 'X'.
- Evaluate the mean of X.

(OR)

b)	For the triangular distribution $f(x) = \begin{cases} x, 0 < x \leq 1 \\ 2 - x, 1 \leq x < 2 \\ 0, \text{otherwise} \end{cases}$	16	K3	CO1
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Find

- The mean and variance.
 - The moment generating function.
 - The cumulative distribution of function $F(x)$.
12. a) i. The number of monthly breakdowns of a computer is a random variable having a Poisson distribution with mean equal to 1.8. Find the probability that this computer will function for a month.
- without breakdown
 - with only one breakdown
 - with atleast one breakdown.
- ii. A manufacture of pins knows that 2% of his products are defective. If he sells pins in boxes of 100 and guarantees that not more than 4 pins will be defective, what is the probability that a box fail to meet the guaranteed quality ?

(OR)

- b) i. State and prove the memory less property of the exponential distribution.
- ii. In a normal distribution, 31% of the items are under 45 and 8% are over 64. Find the mean and variance of the distribution.
13. a) The joint probability mass function of (X, Y) is given $P(x, y) = K(2x + 3y), x = 0, 1, 2; y = 1, 2, 3$. Find all the marginal and conditional probability distributions. Also, find the probability distribution of $P(X + Y)$ and $P(X + Y > 3)$.

(OR)

- b) i. The joint probability density function of a two dimensional random variable (X, Y) is given by
 $f(x, y) = e^{-(x+y)}, 0 \leq x, y \leq \infty$. Are X and Y independent? Why? 8 K3 CO3
- ii. The two lines regression
 $8x - 10y + 66 = 0$ & $40x - 18y - 214 = 0$. The variance of x is 9. Find 8 K3
- a. The mean values of X and Y.
 b. correlation coefficient between X and Y.
14. a) i. If X is a binomial random variable, show that $\hat{p} = \frac{\sum X_i}{n}$ is an unbiased estimator of p. 8 K3 CO4
- ii. Let X_1, \dots, X_n be a random sample from an exponential distribution with parameter λ . Using maximum likelihood estimator, find an unbiased estimator for the parameter λ . 8 K3
- (OR)
- b) i. Suppose that three random samples of sizes 20, 10 and 8 are drawn from a population whose variance is σ^2 . If the respective sample variances S_1^2, S_2^2 and S_3^2 are unbiased estimates of σ^2 , then show that $(20S_1^2 + 10S_2^2 + 8S_3^2)/38$ is also an unbiased estimator of σ^2 . 8 K3 CO4
- ii. The mean muscular endurance score of a random sample of 60 subjects was found to be 145 with standard deviation of 40. 8 K3
- a. Construct 95% and 99% confidence intervals for the true mean.
 b. What size of sample is required to estimate the mean within 5 of the true mean with 95% confidence?
15. a) Two horses A and B were tested according to the time (in seconds) to run a particular race with the followings results: 16 K3 CO5
- | | | | | | | | |
|----------|----|----|----|----|----|----|----|
| Horse: A | 28 | 30 | 32 | 33 | 33 | 29 | 34 |
| Horse: B | 29 | 30 | 30 | 24 | 27 | 29 | |
- Test whether the horse A is running faster than B at 5% level.
- (OR)
- b) i. Two independent samples of sizes 9 and 7 from a normal population had the following values of the variables. 8 K3 CO5
- | | | | | | | | | | |
|-----------|----|----|----|----|----|----|----|----|----|
| Sample I: | 18 | 13 | 12 | 15 | 12 | 14 | 16 | 14 | 15 |
| Sample II | 16 | 19 | 13 | 16 | 18 | 13 | 15 | | |
- Do the estimates of the population variance differ significantly at 5% level?
- ii. Find if there is any association between extravagance in fathers and extravagance in sons from the following data. 8 K3
- | | | |
|-----------------|--------------------|----------------|
| | Extravagant father | Miserly father |
| Extravagant son | 327 | 741 |
| Miserly son | 545 | 234 |