Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 20011

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – JAN. 2026
Fourth Semester
Biotechnology
U23MA408 – BIOSTATISTICS
(Common to BME)
(Regulation 2023)

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 and Chart Tables are Permitted

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	State axioms of probability.	2	K1	CO1
2.	Prove that for any event A in S, $P(A \cap \bar{A}) = 0$.	2	K2	CO1
3.	If Var(X) = 4, then find Var(3X + 8), where X is a random variable.	2	K2	CO2
4.	A discrete R.V X has the probability distribution given below x | 0.5 | 1 | 1.5 | 2 P(x) | k | $2k$ | $3k$ | k Find the value of k.	2	K2	CO2
5.	Show that the mean $\bar{x}$ is an unbiased estimator for the population mean μ.	2	K2	CO3
6.	State any two properties of the maximum likelihood estimator.	2	K1	CO3
7.	Write any two advantages of non-parametric methods over parametric methods.	2	K1	CO4
8.	What is Kolmogorov-Smirnov test? Is it non-parametric?	2	K1	CO4
9.	List the control charts for attributes.	2	K1	CO5
10.	What are lower control limits and upper control limits for c-charts?	2	K1	CO5

PART – B

(5 x 16 = 80 Marks)

Q.No.		Questions	Marks	KL	CO
11. a)	i.	Urn-I contains 8 red and 4 blue balls and urn-II contains 5 red and 10 blue balls. One urn is chosen at random and two balls are drawn from it. Find the probability that both balls are red.	8	K3	CO1
	ii.	In a group of 1000 persons, there are 650 who can speak Hindi, 400 can speak English and 150 can speak both Hindi and English. If a person is selected at random, what is the probability that he speaks a. Hindi only b. English only c. only one of the two languages and d. at least one of the two languages?	8	K3	CO1
		(OR)			
b)	i.	In a bolt factory, machines A, B, C manufacture 25%, 35% and 40% of the total output and out of the total manufacturing 5%, 4% and 2% are defective bolts. A bolt is drawn at random from the product and is found to be defective. Find the probabilities that it is manufactured from a. Machine A b. Machine B and c. Machine C.	8	K3	CO1
	ii.	Given a binary communication channel, where A is the input and B is the output, let $P(A)=0.4$, $P(B/A)=0.9$ and $P(\overline{B}/\overline{A})=0.6$. Find (1) $P(A/B)$ and (2) $P(A/\overline{B})$.	8	K3	CO1
12. a)		A discrete random variables X has the following probability function: X: 0 1 2 3 4 5 6 7 $P(X)$: 0 K $2K$ $2K$ $3K$ K^2 $2K^2$ $7K^2+K$ a. Find K b. Evaluate $P[X < 6], P[X \geq 6]$ c. If $P[X \leq C] > \frac{1}{2}$, Find the minimum value of C d. Evaluate $P[1.5 < X < 4.5 / X > 2]$	16	K4	CO2
		(OR)			

b) The probability density function of a continuous random variable X is given by $f(x)=\begin{cases} ax, & 0\le x\le 1 \\ a, & 1\le x\le 2 \\ 3a-ax, & 2\le x\le 3 \\ 0, & otherwise \end{cases}$ — 16 K4 CO2

i. Find the value of a.

ii. Find the Cumulative distributive function of X.

13. a) i. If $(x_1,x_2,...,x_n)$ is a random sample from the uniform population with the density function $f(x,a,b)=\frac{1}{b-a}; a<x<b$. Find the estimators of a and b by the method of moments. — 8 K3 CO3

ii. A random sample of size n = 100 is taken from a population with $\sigma=5.1$. Given that the sample mean is $\bar{x}=21.6$, construct a 95% confidence interval for the population mean μ. — 8 K3 CO3

(OR)

b) i. Let $X_1,X_2,...,X_n$ be a random sample of size n from the Poisson distribution $f(x\setminus\lambda)=\frac{\lambda^x e^{-\lambda}}{x!}$ where $0\le\lambda<\infty$. Obtain the maximum likelihood estimator of λ. — 8 K3 CO3

ii. In a test given to two groups of students the marks obtained were as follows: — 8 K3 CO3

Group I	18	20	36	50	49	36	34	49	61
Group II	29	28	26	35	30	44	46		

Construct a 95% confidence interval on the mean marks secured by students of the above two groups.

14. a) Use H test to test for the differences in mean among the 3 samples. If $\alpha=0.01$, what are your conclusions? — 16 K4 CO4

Sample I	95	97	99	98	99	99	99	94	95	98
Sample II	104	102	102	105	99	102	111	103	100	103
Sample III	119	130	132	136	141	172	145	150	144	135

(OR)

b) Drop in diastolic blood pressure (in mm mercury) — 16 K4 CO4

Drug D1	10	16	10	4	2	14	4
Drug D2	33	34	41	36	42	42	32

Test whether there is any difference in the effectiveness of drugs at $\alpha=0.05$. Using Wilcoxon's signed rank test.
(Table value for n = 7 is 2)

15. a) The following table gives the sample means and ranges for 10 samples, each of size 6, in the production of certain component. Construct the control charts for mean and range and comment on the nature of control. 16 K4 CO5

Sample No.:	1	2	3	4	5	6	7	8	9	10
Mean	37.3	49.8	51.5	59.2	54.7	34.7	51.4	61.4	70.7	75.3
Range	9.5	12.8	10.0	9.1	7.8	5.8	14.5	2.8	3.7	8.0

(OR)

b) The data given below are the number of defectives in 10 samples of 100 items each. Construct a p-chart and np-chart and comment on the results: 16 K4 CO5

Samples	1	2	3	4	5	6	7	8	9	10
No. of. Defectives	6	16	7	3	8	12	7	11	11	4