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: 20014

M.E. / M.Tech. DEGREE END-SEMESTER EXAMINATIONS – JAN. / FEB. 2026
First Semester
Biotechnology
P23MA103 - APPLIED STATISTICS FOR BIOTECHNOLOGISTS
(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 Table is Permitted

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Let A and B be the possible outcomes of an experiment and suppose $P(A) = 0.4, P(A \cup B) = 0.7, and\ P(B) = p$. For what choice of 'p' are A and B mutually exclusive? For what choice of 'p' are A and B independent?	2	K1	CO1
2.	Identify the nature of the following random variables as Discrete/Continuous. S1: Amount of rainfall measured in a city. S2: The number of children in a family.	2	K2	CO1
3.	Assume the probability of the beneficial mutation occurring in any single cell division is p=0.001. What is the probability that the first mutation occurs exactly on the 5th cell division (k=5)?	2	K1	CO2
4.	The time to repair a machine is exponentially distributed with parameter $\lambda = 1/2$. What is the probability that the repair time exceeds 2h?	2	K1	CO2
5.	What is the correlation coefficient for the bivariate data set: (1,1), (2,1), (3,1), (4,1), and (5,1)?	2	K1	CO3
6.	How do linear and nonlinear correlation differ?	2	K1	CO3
7.	Define Type-I and Type-II error.	2	K1	CO4
8.	How is t-distribution differ from F-distribution?	2	K1	CO4
9.	What is ANOVA? When is it used?	2	K1	CO5
10.	What is randomization in design of experiments?	2	K1	CO5

PART – B

(5 x 16 = 80 Marks)

Q.No.			Questions	Marks	KL	CO
11.	a)	i.	A random variable X has the following probability function: a. Find the value of K and calculate the mean and variance. b. Construct the CDF F(X) and draw its graph.	8	K3	CO1

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

		ii.	The chance that a doctor A will diagnose a disease correctly is 60%. The chance that a patient will die by his treatment after correct diagnosis is 40% and the chance of death by wrong diagnosis is 70%. A patient of doctor A, who had disease died. What is the chance that his disease was diagnosed correctly.	8	K3	CO1
			(OR)			
	b)	i.	In four tosses of a coin, Let X be the number of heads. Tabulate the 16 possible outcomes with the corresponding values of X. By simple counting derive the distribution of X and hence calculate the expected value of X.	8	K3	CO1
		ii.	A coin is tossed until a head appears. What is the expectation of the number of tosses required? Provide a detailed calculation.	8	K3	CO1
12.	a)	i.	It is found that the number of serious gastrointestinal reactions reported to the Committee on Safety of Medicine was 538 for 9,160,000 prescriptions of the anti-inflammatory drug piroxicam. This corresponds to a rate of 0.058 gastrointestinal reactions per 1000 prescriptions written. Using a Poisson model for probability, with $\lambda = 0.06$, find the probability of a. Exactly one gastrointestinal reaction in 1000 prescriptions b. Exactly two gastrointestinal reactions in 1000 prescriptions c. No gastrointestinal reactions in 1000 prescriptions and d. At least two gastrointestinal reaction in 1000 prescriptions.	8	K3	CO2
		ii.	In a study on common breath metabolites in five subjects over a period of 30 days, breath samples were taken and analyzed each day in the early morning on arrival at the laboratory. For a 27-year-old female, the ammonia concentration in parts per billion (ppb) followed a normal distribution over 30 days with mean 491 and standard deviation 119. What is the probability that on a random day, the subject's ammonia concentration is a. between 292 and 649 ppb b. Greater than 649 ppb c. Less than 292 ppb.	8	K3	CO2

(OR)

b) i. The joint probability mass function of (X,Y) is given by $p(x,y) = k(2x+3y), x = 0,1,2;\ y = 1,2,3$. Find the marginal distributions of X and Y and find the conditional probability distribution of X given $Y = 2$. 8 K3 CO2

ii. Given $f_{XY}(x,y) = \begin{cases} cx(x-y), 0 < x < 2,\ -x < y < x, \\ 0\ elsewhere \end{cases}$. 8 K3 CO2

a. Find the value c
b. Find $f_X(x)$ and
c. $f_Y(y)$.

13. a) i. A biologist is studying the relationship between the mass of a certain type of frog and the length of its hind leg. They collect the following data from a sample of seven frogs: Calculate the regression equation that models this relationship in the form $y = ax + b$. Predict the mass of a frog with a hind leg length of 8.0 cm using your regression equation. 8 K3 CO3

Length(cm)x	5.2	5.8	6.5	7.1	7.8	8.4	9.1
Mass(g)y	85	90	100	115	125	130	145

ii. The following table gives the distribution of the total population and those who are blind among them. Construct out if there is any relation between age and blindness: 8 K3 CO3

Age	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Blind	55	40	40	40	36	22	18	15

(OR)

b) i. A random sample of 5 college students is selected and their grades in mathematics and statistics are found to be: Construct Pearman's rank correlation coefficient. 8 K3 CO3

Subject	1	2	3	4	5
Mathematics	85	60	73	40	90
Statistics	93	75	65	50	80

ii. A research team measures the average body mass and basal metabolic rate for several species of mammals. They collect the following data: Fit a power curve for the data $y = ax^b$. 8 K3 CO3

Species	Mouse	Cat	Dog	Human	Cow
Body mass(X)	0.02	4	15	70	600
Metabolic rate(Y)	0.17	24	60	90	400

14. a) i. In a sample of 1000 people in a state 540 are rice eaters and the rest are wheat eaters. Can we assume that both rice and whet are equally popular in this state at 1% level of significance? 8 K4 CO4

ii. The mean height of two large samples of sizes 1000 and 2000 members are 67.5 inches and 69.0 inches respectively. Analyze the samples be regarded as drawn from the same population of standard deviation 2.5 inches. 8 K4 CO4

(OR)

b) i. Out of 1660 candidates who appeared for a competitive examination., 422 were successful. Out of these, 256 had attended a coaching class and 150 of them came out successful. Test whether coaching was effective as regards the success in the examination. 8 K4 CO4

ii. Memory capacity of the students was tested before and after giving the nourishing food. Test whether the nourishing food was effective or not from the following scores. 8 K4 CO4

Subject	1	2	3	4	5	6	7	8	9	10
Before	12	14	11	8	7	10	3	0	5	6
After	15	16	10	7	5	12	10	2	3	8

15. a) Two drugs were simultaneously administered to patients to control body temperature. The number of days required to come to normal temperature were recorded and presented. Test the significant difference between doses of two drugs A and B using two-way analysis of variance technique at 5 percent level of significance. 16 K4 CO5

Drug A	Drug B		
	50mg	100mg	150mg
50mg	10	8	7
100mg	9	6	5
150mg	8	4	3
200mg	7	3	2

(OR)

b) Analyze the variance for the following Latin square design: 16 K4 CO5

20	B	17	C	25	D	34	A
23	A	21	D	15	C	24	B
24	D	26	A	21	B	19	C
26	C	23	B	27	A	22	D