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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Bio-Technology **Duration: 3 hrs.**
Course Code: 19MA4BSBSP **Max Marks: 100**
Course: BIOSTATISTICS AND PROBABILITY

Instructions:
1. All units have internal choices, answer one complete question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Statistical tables is permitted.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - 1	**CO**	**PO**	**Marks**
1	a)	Fit a curve of the form $y = ab^x$ in the least square sense for the following data: x: 0, 2, 4, 5, 7, 10 y: 100, 120, 256, 390, 710, 1600	*1*	*1*	**6**
	b)	If θ is the angle between two regression lines, show that $\tan\theta = \frac{1-r^2}{r}\left(\frac{\sigma_x\sigma_y}{\sigma_x^2+\sigma_y^2}\right)$.	*2*	*1*	**7**
	c)	In a test on electric bulbs, it was found that the life time of a particular brand was distributed normally with an average life of 2040 hours and standard deviation of 60 hours. If a firm purchases 2000 bulbs, find the number of bulbs that are likely to last for: i) more than 2150 *hrs*, ii) less than 1950 *hrs.*	*2*	*1*	**7**
		OR			
2	a)	Fit a second-degree polynomial of the form $y = a + bx + cx^2$ for the data x: 0, 1, 2, 3, 4 y: 1, 1.8, 1.3, 2.5, 6.3	*1*	*1*	**6**
	b)	Find the coefficient of correlation for the following data and hence obtain the lines of regression: x: 1, 2, 3, 4, 5, 6 y: 9, 8, 10, 12, 11, 13	*2*	*1*	**7**
	c)	Derive the mean and standard deviation of Poisson distribution.	*2*	*1*	**7**
		UNIT - 2			
3	a)	A coin is tossed three times. Let X denote 0 or 1 according as tail or head occurs on the first toss. Let Y denote the total number of tails which occur. Determine (i) the marginal distributions of X and Y, (ii) the joint distributions of X and Y (iii) Also find $E(X+Y)$.	*3*	*1*	**6**

b) Define regular stochastic matrix and hence show that the stochastic matrix $A=\begin{bmatrix} 0 & 3/4 & 1/4 \\ 1/2 & 1/2 & 0 \\ 0 & 1 & 0 \end{bmatrix}$ is regular. — 2 | 1 | **7**

c) A habitual gambler is a member of two clubs A and B. He visits either of the clubs every day for playing cards. He never visits club A on two consecutive days. But, if he visits club B on a particular day, then the next day he is as likely to visit club B or club A. — 2 | 1 | **7**

(i) Find the transition matrix of this Markov chain.

(ii) If the person had visited club B on Monday, find the probability that he visits club A on Thursday.

OR

4 a) The joint probability distribution of two random variables X and Y is given below: — 3 | 1 | **6**

X \ Y	-3	2	4
1	0.1	0.2	0.2
3	0.3	0.1	0.1

Determine (i) $E(X+Y)$, (ii) $E(X^2)$, (iii) $E(Y)$.

b) The joint probability function of two random variable X and Y is given by $f(x,y)=k(2x+3y)$ for $0 \le x \le 2; 1 \le y \le 3$. — 2 | 1 | **7**

(i) Find the constant k.

(ii) Calculate marginal distribution of X and Y.

(iii) Whether or not X and Y are independent.

c) A housewife buys 3 kinds of cereals A, B, and C. She never buys the same cereal in successive weeks. If she buys cereal A, the next week she buys cereal B. However, if she buys cereal B or C, the next week she is three times as likely to buy cereal A as the other cereal. In the long run how often she buys each of the three cereals? — 2 | 1 | **7**

UNIT - 3

5 a) A manufacturer of women's beauty products is considering four new variations of a hair dye. An important consideration in a hair dye is its lasting power; defined as the number of days until treated hair becomes indistinguishable from untreated hair. To learn about the lasting power of its new variations, the company hired three long-haired women. Each woman's hair was divided into four sections, and each section was treated by one of the dyes. The following data concerning the lasting power resulted. — 4 | 1 | **10**

Women	Dye			
	1	2	3	4
1	15	20	27	21
2	30	33	25	21
3	37	44	41	46

Analyse the data by applying RBD technique at $\alpha = 1\%$.

		b)	Estimate the missing value and construct the ANOVA table for the Latin Square design at $\alpha = 1\%$.	4	1	**10**

A-10	B-11	C-14	D-13
B-9	C-?	D-15	A-11
C-14	D-9	A-10	B-12
D-8	A-12	B-13	C-11

OR

6	a)	A paeditrician speculated that frequency of visits to his office may be influenced by type of medical insurance coverage. As an exploratory study, she randomly chose 15 patients: 5 whose parents belong to a health maintenace organisation (A), 5 whose parents had traditional medical insurance (B), and 5 whose parents were uninsured(C). Using the frequency of visits per year given below, test the hypothesis that type of insurance coverage has no effect on frequency of visits $\alpha = 5\%$. A-12,C-3,B-6,C-1,B-1,B-5,B-7,A-6,B-5,A-8,C-2,C-5,A-7,A-6,C-3	4	1	**10**
	b)	Estimate the missing value and hence analyse the RBD for the data at $\alpha = 1\%$.	4	1	**10**

A-4	E-10	D-7	B-3	C-11
C-5	E-3	D-?	A-10	B-7
A-6	B-3	C-7	D-4	E-10

UNIT - 4

7	a)	The mean and standard deviation of the diameters of a sample of 250 rivet heads manufactured by a company are 7.2642 mm and 0.0058 mm respectively. Find 99% confidence limits for the mean diameter of all the rivet heads manufactured by the company.	4	1	**6**
	b)	In 210 families of females with primary unipolar major depression, they found that alcoholism was present in 89. Of 299 control families, alcoholism was present in 94. Do these data provide sufficient evidence for us to conclude that alcoholism is more likely to be present in females of subjects with unipolar depression at 5% level of significance?	4	1	**7**
	c)	Intelligence test of two groups of boys and girls gives the following results.	4	1	**7**

	Girls	Boys
Number of students	121	81
Mean(score)	84	81
Standard deviation(score)	10	12

Is the difference between the standard deviations significant at $\alpha = 1\%$?

OR

8	a)	A pharmaceutical firm claims that the mean time for a drug to take effect is 24 minutes. In a sample of 400 trials, the mean time is 26 minutes with a standard deviation of 4 minutes. Test if the mean time for a drug to be effective is significant at $\alpha = 1\%$.	4	1	**6**
	b)	In a sample of 200 items produced by a machine, 15 were found defective, while in another sample of 100 items produced by another machine, 12 were found defective. Find 99% confidence limits for the difference in proportions of defective items produced by the two machines.	4	1	**7**

c) In an elementary school examination, the mean grade of 32 boys was 72 with a standard deviation of 8, while the mean grade of 36 girls was 75 with a standard deviation of 6. Test the hypothesis that the average performance of girls is better than boys at $\alpha = 1\%$. | 4 | 1 | **7**

UNIT - 5

9 a) Consider a random sample of 500 U.S. adults who are questioned regarding their political affiliation and opinion on a tax reform bill. Apply Chi-Square to test if the political affiliation and their opinion on a tax reform bill are dependent at a 5% level of significance. The observed contingency table is given below. | 4 | 1 | **6**

	Favor	Indifferent	opponent
Democrat	138	83	64
Republican	64	67	84

b) The pulsality index (P.I.) of 7 patients before and after contracting a disease is given below. Test at 0.05 level of significance whether there is a significant increase of the mean of P.I. values. | 4 | 1 | **7**

Before	0.4	0.45	0.44	0.54	0.48	0.62	0.48
After	0.5	0.6	0.57	0.65	0.63	0.78	0.63

c) Two independent samples of sizes 7 and 6 have the following values. | 4 | 1 | **7**

Sample A:	28	30	32	33	33	29	34
Sample B	29	30	30	24	27	29	-

Apply F-test to examine whether the samples have been drawn from normal populations having the same variance at $\alpha = 1\%$.

OR

10 a) A group of boys and girls were given an intelligence test. The data are as follows: | 4 | 1 | **6**

	Boys	Girls
Mean	124	121
Standard deviation	12	10
Sample size	18	14

Is the mean score of boys significantly different from that of girls at $\alpha = 5\%$?

b) It is believed that the proportion of people with A, B, O and AB blood types in a population are respectively 0.4, 0.2 0.3 and 0.1. When 400 randomly picked people were examined, the number of persons with these types was observed to be 148, 96,106 and 50 respectively. Apply Chi-Square to test the hypothesis that these data bear out the stated belief at $\alpha = 1\%$. | 4 | 1 | **7**

c) The effects of two drugs on reaction time to a certain stimulus were studied in three samples of experimental animals. Sample III served as a control while the animals in sample I were treated with drug A and those in sample II were treated with drug B prior to the application of the stimulus. The following table shows the reaction times in seconds of 13 animals. | 4 | 1 | **7**

Sample I	17	20	40	31	35
Sample II	8	7	9	8	-
Sample III	2	5	4	3	-

Can we conclude that three populations represented by the three samples differ with respect to reaction time? Use Kruskal Wallis One Way Analysis of Variance at $\alpha = 1\%$.

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