U.S.N.										

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

Autonomous Institute Affiliated to VTU

September / October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23MA4BSSAP / 22MA4BSSAP **Max Marks: 100**
Course: Statistics and Probability

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Statistical tables are permitted.

			CO	PO	Marks
		UNIT - 1			
1	a)	In a partially destroyed laboratory record, only the lines of regression of y on x and x on y are available as $4x-5y+33=0$ and $20x-9y=107$ respectively. Calculate $\bar{x}$, $\bar{y}$ and the co-efficient of correlation between x and y.	1	1	**6**
	b)	If V (km/hr) and R (kg/ton) are related by a relation of the type $R=a+bV^2$, find a & b by the method of least squares with the help of the following table.	1	1	**7**
	c)	Establish the formula $r=\dfrac{\left(\sigma^2_{ax+by}\right)-\left(a^2\sigma_x^2+b^2\sigma_y^2\right)}{2\,ab\sigma_x\,\sigma_y}$.	1	1	**7**
		OR			
2	a)	Derive an expression for mean and variance for the Poisson distribution.	1	1	**6**
	b)	Fit a relation of the form $y=ab^x$ to the following data by applying principle of least squares.	1	1	**7**
	c)	In a normal distribution, 7% of the items are under 35 and 89% are under 63. Find the mean and standard deviation of the distribution.	1	1	**7**
		UNIT – 2			
3	a)	Find the fixed probability vector of $P=\begin{bmatrix}0 & 0.75 & 0.25\\ 0.5 & 0.5 & 0\\ 0 & 1 & 0\end{bmatrix}$	1	1	**6**

V	10	20	30	40	50
R	8	10	15	21	30

x	2	3	4	5	6
y	144	172.8	207.4	248.8	298.5

		b)	Each year a man trades his car for a new car in 3 brands of the popular company Maruti Udyog Limited. If he has "Ciaz", he trades it for "Alto". If he has a "Alto", he trades it for "Swift". If he has "Swift", he is just as likely to trade it for a new "Swift" or for a "Alto" or a "Ciaz". In 2020 he bought his first car which was "Swift". Find the probability that he has on 2023 "Swift" and on 2023 "Alto".	*1*	*1*	**7**
		c)	Two flashcards are selected at random from a box which contains five cards numbered 1, 2, 2, 3, 3. Find the joint distributions of X and Y where X denotes the sum of two numbers and Y denote the minimum of two numbers drawn. Also, determine $Cov(X, Y)$.	*1*	*1*	**7**
			UNIT – 3			
	4	a)	Test whether the average number of days of absence per worker through sickness has changed this year compared with the average value in the past which was 8 days, with a standard deviation of 14 days. Given that a random sample of 49 workers taken gave a mean of 10.6 days of absence per worker this year. Conduct the test at 5% level of significance.	*1*	*2*	**6**
		b)	The mean yield of two sets of plots and their variability are as given below. Examine whether the difference in the variability in yields is significant at 1% level of significance. Set of 121 plots: Mean yield per plot = 84 lb; Standard deviation per plot = 10 Set of 81 plots: Mean yield per plot = 81 lb; Standard deviation per plot = 12	*1*	*2*	**7**
		c)	A machine produced 20 defective articles in a batch of 400. After overhauling, it produced 10 defectives in a batch of 300. Has the machine improved? Test at 5% level of significance.	*1*	*2*	**7**
			UNIT – 4			
	5	a)	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. At 5% level of significance, test the hypothesis that these data bear out the stated belief.	*1*	*2*	**6**
		b)	Three nutrients were examined for the height of seedlings and the following data is recorded: Height of seedlings Nutrients A: 22 20 21 18 16 14 Nutrients B: 12 14 15 10 9 - Nutrients C: 7 9 7 6 - - Perform one-way ANOVA at 1% level of significance.	*1*	*2*	**7**

		c)	In the built-in data set survey, the smoke column records the workers smoking habit, while the Exercise column records their exercise level. The allowed values in smoke are "Heavy", "Regularly, "Occasionally" and "Never". As for exercise, they are "Frequently", "Some" and "None". Test the hypothesis whether the workers smoking habit is independent of their exercise level at 1% significance level.	*1*	*2*	**7**
			OR			
	6	a)	Following data gives weight gains of 8 pairs of experimental animals matched with respect to various growth factors. One of each pair, selected by chance, was given vitamin B_{12} supplement and the other was not given the supplement. Test whether B_{12} supplement is beneficial at 5% level of significance.	*1*	*2*	**6**
		b)	Cortisol level of determinations were made on 2 samples of women at child birth. Group 1 subjects underwent emergency cesarean section following induced labor. Group 2 subjects delivered by either cesarean section or the vaginal route following spontaneous labor. The sample sizes, mean cortisol levels and standard deviation were as follows: Do these data provide sufficient evidence to indicate a difference in the mean cortisol levels in the population represented? Use 1% level of significance.	*1*	*2*	**7**
		c)	A textile company is trying to develop a green dye which will produce a consistent shade of green in cotton material. Two different formulations are tried out, the first on 10 test squares of cotton and the second on 8 test squares. The depth of colour of each square of material is then assessed on a points scale. The standard deviation of the 10 squares on which the first dye was used is 3.0 and that of the 8 squares treated with the second dye is 6.4. Does this establish that the both dyes produce same results? Use 1% level of significance.	*1*	*2*	**7**

Smoke	Exercise Levels		
	Frequently	Some	None
Heavy	7	1	3
Never	87	18	84
Occasionally	12	3	4
Regularly	9	1	7

Pair	1	2	3	4	5	6	7	8
With B_{12}	1.6	1.68	1.75	1.64	1.75	1.79	1.78	1.77
Without B_{12}	1.56	1.52	1.52	1.49	1.59	1.56	1.6	1.56

Sample	Sample Sizes	Mean	S.D.
1	10	435	65
2	12	645	80

			UNIT – 5			
	7	a)	Data recorded on yield of four varieties in an experiment with four replications for which one value is missing. Estimate the missing value and analyse the data at 5% level of significance. <table><tr><td>P 5.52</td><td>R 5.57</td><td>Q 5.071</td><td>S 9.16</td></tr><tr><td>S 6.69</td><td>R 5.14</td><td>Q -</td><td>P 6.09</td></tr><tr><td>S 2.89</td><td>P 6.02</td><td>Q 6.53</td><td>R 2.83</td></tr><tr><td>R 9.76</td><td>Q 6.25</td><td>S 8.9</td><td>P 9.77</td></tr></table>	*1*	*2*	**10**
		b)	A manufacturing firm wants to investigate the effects of 5 colour additives on the acting time of a new concrete mix. Variations in the setting times can be expected from day-to-day changes and humidity and also from the different workers who prepare the test molds. The data is given below with the letters A, B, C, D and E representing the five additives. The setting times, in hours, for the 25 molds are shown below. <table><tr><td rowspan="2">Worker</td><td colspan="5">Day</td></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>1</td><td>D-10.7</td><td>E-10.3</td><td>B-11.2</td><td>A-10.9</td><td>C-10.5</td></tr><tr><td>2</td><td>E-11.3</td><td>C-10.5</td><td>D-12</td><td>B-11.5</td><td>A-10.3</td></tr><tr><td>3</td><td>A-11.8</td><td>B-10.9</td><td>C-10.5</td><td>D-11.3</td><td>E-7.5</td></tr><tr><td>4</td><td>B-14.1</td><td>A-11.6</td><td>E-11</td><td>C-11.7</td><td>D-11.5</td></tr><tr><td>5</td><td>C-14.5</td><td>D-11.5</td><td>A-11.5</td><td>E-12.7</td><td>B-10.9</td></tr></table>Using appropriate design analyse the data at 5% level of significance.	*1*	*2*	**10**

****