U.S.N.										

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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Electronics and Communication Engineering **Duration: 3 hrs.**
Course Code: 19EC5PE1PS **Max Marks: 100**
Course: Probability and Statistics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

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.

<table>
<tr><th></th><th></th><th>UNIT – I</th><th>CO</th><th>PO</th><th>Marks</th></tr>
<tr><td>1</td><td>a)</td><td>A shipment of 20 similar laptop computers to a retail outlet contains 3 that are defective. If a school makes a random purchase of 2 of these computers, find the
probability distribution for the number of defectives.</td><td>CO 1</td><td>PO1</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>Two ballpoint pens are selected at random from a box that contains 3 blue pens, 2 red pens, and 3 green pens. If X is the number of blue pens selected and Y is the number of red pens selected, find
(a) the joint probability function f(x, y),
(b) P[(X, Y) ∈ A],
where A is the region {(x, y)|x + y ≤ 1}.</td><td>CO 1</td><td>PO1</td><td>10</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>a)</td><td>The school of international studies for population found out by its survey that the mobility of a population of a state to the village, town and city is in following percentages.
i. Interpret the state transition matrix is terms of Retention & loss
ii. Draw transition diagram
<table>
<tr><td></td><td colspan="4">To</td></tr>
<tr><td rowspan="4">From</td><td></td><td>Village</td><td>Town</td><td>City</td></tr>
<tr><td>Village</td><td>50%</td><td>30%</td><td>20%</td></tr>
<tr><td>Town</td><td>10%</td><td>70%</td><td>20%</td></tr>
<tr><td>City</td><td>10%</td><td>40%</td><td>50%</td></tr>
</table>
</td><td>CO 1</td><td>PO1</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>Three boys A,B,C are throwing a ball each other. A always throws the ball to B and B always throws the ball to C, but C is as likely to throw the ball to B as to A. If the initial probability distribution of three states A,B and C is 0.3,0.4 and 0.3 respectively. Find
i. The transition matrix
ii. P(X2 = B)
iii. P(X3 = B, X2=C, X1 =B,X0 = A)</td><td>CO 1</td><td>PO1</td><td>10</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>UNIT – II</td><td></td><td></td><td></td></tr>
<tr><td></td><td>3</td><td>a)</td><td>What are the classifications of the Random process? Explain with an example.</td><td>-</td><td>-</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Consider a sinusoidal process X(t)= Cos2πfct where fc is constant and the amplitude A is uniformly distributed:
$$f_A(a) = \begin{cases} 1, & 0 \leq a \leq 1 \\ 0, & \text{otherwise} \end{cases}$$
Determine whether or not this process is strictly stationary.</td><td><i>CO1</i></td><td><i>PO1</i></td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>4</td><td>a)</td><td>A random variable X has the following probability distribution.
<table>
<tr><td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>P(X)</td><td>0.1</td><td>k</td><td>0.2</td><td>2k</td><td>0.3</td><td>3k</td></tr>
</table>
i. Find k
ii. Evaluate P(X<2) and P(-2<X<2)
iii. Find CDF of X
Evaluate mean of X.</td><td><i>CO1</i></td><td><i>PO1</i></td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>Discuss the properties of the correlation function.</td><td>-</td><td>-</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Consider a sinusoidal process X(t)= Cos2πfct where fc is constant and the amplitude A is uniformly distributed:
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<tr><td></td><td></td><td></td><td>UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td></td><td>5</td><td>a)</td><td>Find the equation of the best fitting straight-line y=a+bx for the following data & hence estimate the value of the dependent variable corresponding at the value 30 of the independent variable.
<table>
<tr><td>x</td><td>y</td></tr>
<tr><td>5</td><td>16</td></tr>
<tr><td>10</td><td>19</td></tr>
<tr><td>15</td><td>23</td></tr>
<tr><td>20</td><td>26</td></tr>
<tr><td>25</td><td>20</td></tr>
</table></td><td><i>CO1</i></td><td><i>PO1</i></td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>What is meant by Measures of Variability? Explain with an example</td><td>-</td><td>-</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>Derive the expression for angle between two regression lines?</td><td><i>CO1</i></td><td><i>PO1</i></td><td>5</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>6</td><td>a)</td><td>Find the correlation coefficient between x and y from the following data.
<table>
<tr><td>x</td><td>78</td><td>89</td><td>97</td><td>69</td><td>59</td><td>79</td><td>68</td><td>57</td></tr>
<tr><td>y</td><td>125</td><td>137</td><td>156</td><td>112</td><td>107</td><td>138</td><td>123</td><td>108</td></tr>
</table></td><td><i>CO1</i></td><td><i>PO1</i></td><td>12</td></tr>
</table>

		b)	Define correlation? Explain the different types of correlation with example	-	-	**8**
			UNIT – IV			
	7	a)	A papulation consists of 5,10,14,18,13,24. Consider all possible samples of size two which can be drawn without replacement from the population. Find i. Mean of the population ii. Standard deviation of the papulation iii. Mean of sampling distribution of means iv. Standard deviation of sampling distribution of means	***CO1***	***PO1***	**12**
		b)	Explain Chi-square test with the expression? What are the conditions for its validity?	-	-	**8**
			OR			
	8	a)	A random sample of size 64 is taken from a normal population with μ=51.4 and σ = 6.8.what is the probability that the mean of the sample will be a) Exceed 52.9 b) Fall between 50.5 and 52.3 c) Less than 50.6	***CO1***	***PO1***	**10**
		b)	Explain the Central limit theorem. Illustrate the same for large and small size samples	-	-	**10**
			UNIT – V			
	9	a)	Suppose that the lifetime of badger brand light bulbs is modelled by an exponential distribution with (unknown) parameter lamda. We test 5 bulbs and find they have lifetimes of 2,3,1,3 and 4 years, respectively. What is the Maximum Likelihood Estimator for lamda.	***CO1***	***PO1***	**6**
		b)	A coin is flipped 100 times. Given that there were 55 heads, find the maximum likelihood estimate for the probability 'p' of heads on a single toss.	***CO1***	***PO1***	**6**
		c)	Explain how the Neyman-Pearson lemma is applied to construct the best test of the hypothesis?	***CO1***	***PO1***	**8**
			OR			
	10	a)	Suppose 10 rats are used in a biomedical study where they are injected with cancer cells and then given a cancer drug that is designed to increase their survival rate. The survival times, in months, are 14, 17, 27, 18, 12, 8, 22, 13, 19, and 12. Assume the probability distribution function to be $f(x,\beta) = \begin{cases} \frac{1}{\beta}e^{-x/\beta}, & x > 0, \\ 0, & \text{elsewhere.} \end{cases}$ Give a maximum likelihood estimate of the mean survival time.	***CO1***	***PO1***	**10**

		b)	The average weight of all residents in town XYZ is 168 lbs. A nutritionist believes the true mean to be different. She measured the weight of 36 individual and found the mean to be 169.5 lbs with a standard deviation of 3.9. a. State the null and alternate hypothesis. b. At a 95% confidence level, is there enough evidence to discard the null hypothesis. c. Use both z-test and p-value test.	***CO1***	***PO1***	**10**

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