Bapuji Educational Association®
Bapuji Institute of Engineering and Technology, Davanagere
An Autonomous Institute Affiliated to VTU

Third Semester BE/B Tech Degree Examination: February/March 2026

Model Question Paper

Course: Mathematics-III for CS and Engineering (BCSASC301)

Maximum Marks: 100 **Duration: 3 Hours**

Instructions to the Students:

1. Answer any 5 full questions by choosing one full question from each module.
2. Mathematics Formula handbooks are allowed.

Q. No.	Question	Marks	RL	CO
	Module 1			
1 a)	A random variable X has the following probability function for various values of x X: 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 P(X): 0 | k | 2k | 2k | 3k | k^2 | $2k^2$ | $7k^2+k$ Determine i) the value of k $ii)\ P(x < 6)\ \ iii)\ P(0 < x < 5)\ iv)\ P(x \geq 6)$	6	L3	2
1 b)	Derive an expression for mean, variance and standard deviation of Poisson distribution.	7	L2	1
1 c)	In a test on 2000 electric bulbs, it was found that the life of a particular make was normally distributed with an average life of 2040 hours and standard deviation of 60 hours. Determine the number of bulbs likely to burn for i) More than 2150 hours ii) less than 1950 hours iii) between 1920 and 2160 hours.	7	L3	2
	OR			
2a)	A random variable X has probability density function $f(x) = \begin{cases} kx^2, & 0 \leq X \leq 3 \\ 0, & otherwise \end{cases}$, Determine i) the value of k, ii) $P\ (x \leq 1)$ iii) $P(x > 1)$ iv) $P\ (1 \leq x \leq 2)$	6	L3	2
2 b)	Derive an expression for mean, variance and standard deviation of Poisson distribution.	7	L2	1
2 c)	In a certain town the duration of a shower is exponentially distributed with mean 5minutes. Determine the probability that a shower will last for, (i)10 minutes or more (ii) less than 10 minutes (iii) between 10 and 12 minutes.	7	L3	2
	Module 2			
3 a)	The joint probability distribution of discrete random variables X & Y is as follows: X \ Y: -4 | 2 | 7 1: 1/8 | 1/4 | 1/8 5: 1/4 | 1/8 | 1/8 Compute i) E(X) and E(Y) ii) E(XY) iii) σ_X and σ_Y iv) $\rho(X, Y)$	6	L3	2

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3 b)	If $P_1 = \begin{bmatrix} 1-a & a \\ b & 1-b \end{bmatrix}$ and $P_2 = \begin{bmatrix} 1-b & b \\ a & 1-a \end{bmatrix}$. Show that P_1, P_2 and P_1P_2 are stochastic matrices.	7	L2	2
3 c)	Three boys A, B, C are throwing a ball to each other. A always throws the ball to B & B always throws the ball to C. C is just as likely to throw the ball to B or as to A. Construct Transition probability matrix. If C is the first person to throw the ball, determine the probability that after three throws, A has the ball ii) B has the ball iii) C has the ball	7	L3	2
	OR			
4 a)	If the joint probability distribution of X and Y is given by $f(x,y) = \frac{x+y}{30}$, for $x = 0,1,2,3; y = 0,1,2$ Determine i) $P(X \leq 2, Y = 1)$ ii) $P(X > 2, Y \leq 1)$ iii) $P(X > Y)$	6	L3	2
4 b)	Show that the fixed probability vector of the regular stochastic matrix $A = \begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 1 & 0 \end{bmatrix}$ is $\left(\frac{4}{11}, \frac{4}{11}, \frac{3}{11}\right)$	7	L2	2
4 c)	A gambler's luck follows a pattern. If he wins a game, the probability of winning next game is 0.6. However, if he loses the game, the probability of losing the next game is 0.7. There is an even chance of gambler winning the first game if so, i) Determine the probability of winning the second game? ii) Determine the probability of winning the third game? iii) In the long run, investigate how often he will win.	7	L3	2
	Module 3			
5 a)	Explain (i) Null hypothesis (ii) critical region (iii) Type-I and type-II errors	6	L2	1
5 b)	In 324 throws of a six faced die, an odd number turned up 181 times. Determine whether it is reasonable to think that the die is unbiased one at 5% level of significance.	7	L3	4
5 c)	In a city A, 20 % of a random sample of 900 school boys had a certain slight physical defect. In another city B, 18.5% of a random sample of 1600 school boys had the same defect. Determine whether the difference between the proportions is significant at 5% significance level.	7	L3	4
	OR			
6 a)	Explain (i) Standard error (ii) Statistical hypothesis (iii) confidence limits	6	L2	1
6 b)	In a locality of 18000 families a sample of 840 families was selected at random. Of these 840 families, 206 families were found to have monthly income of Rs. 2500 or less. It was desired to investigate how many of the 18,000 families have monthly income of Rs. 2500 or less. Determine the limits Within which the estimate lies	7	L3	4

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<table>
<tr><th>Q. No.</th><th>Question</th><th>Marks</th><th>RL</th><th>CO</th></tr>
<tr><td>6 c)</td><td>The mean life time of a sample of 100 fluorescent tube lights manufactured by a company is found to be 1570 hrs with a standard deviation of 120 hrs. Investigate whether the mean life-time of the lights produced by the company is 1600 hrs at 0.01 level of significance.</td><td>7</td><td>L3</td><td>4</td></tr>
<tr><td colspan="5">Module 4</td></tr>
<tr><td>7 a)</td><td>State Central Limit theorem. Use the theorem to compute
$P[50 < \bar{X} < 56]$, where $\bar{X}$ represents the mean of a random sample of size 100 from an infinite population with mean $\mu = 53$ and variance $\sigma^2 = 400$</td><td>6</td><td>L3</td><td>3</td></tr>
<tr><td>7 b)</td><td>A certain stimulus administered to each of the 12 patients resulted in the following change in the blood pressure 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0 and 4. Investigate whether the stimulus will increase the blood pressure. ($t_{0.05} = 2.201$ for 11 d.f)</td><td>7</td><td>L3</td><td>4</td></tr>
<tr><td>7 c)</td><td>Four coins are tossed 100 times and the following results were obtained:
<table>
<tr><td>No. of heads</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Frequency</td><td>5</td><td>29</td><td>36</td><td>25</td><td>5</td></tr>
</table>
Fit a binomial distribution for the data and investigate the goodness of fit.
(Given that $\chi^2_{0.05} = 9.49$ for 4 d.f)</td><td>7</td><td>L3</td><td>4</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>8 a)</td><td>Suppose that 10, 12, 16 and 19 is a sample taken from a normal population with variance 6.25. Determine 95% confidence interval for population mean.</td><td>6</td><td>L3</td><td>3</td></tr>
<tr><td>8 b)</td><td>Two types of batteries are tested for their length of life and the following results are obtained:
Battery A:$n_1 = 10, \bar{x}_1 = 500\text{hrs.}, \sigma_1^2 = 100$
Battery B: $n_2 = 10, \bar{x}_2 = 560\text{hrs.}, \sigma_2^2 = 121$
Compute student's t and investigate whether there is a significant difference in the two means. ($t_{0.05} = 2.101$ for 18 d.f)</td><td>7</td><td>L3</td><td>4</td></tr>
<tr><td>8 c)</td><td>Two random samples gave the following data:
<table>
<tr><th>Sample</th><th>Size</th><th>Mean</th><th>Variance</th></tr>
<tr><td>Sample I</td><td>8</td><td>9.6</td><td>1.2</td></tr>
<tr><td>Sample II</td><td>11</td><td>16.5</td><td>2.5</td></tr>
</table>
Investigate whether the two samples have been drawn from the same normal population. ($F_{10,7} = 3.64$)</td><td>7</td><td>L3</td><td>4</td></tr>
<tr><td colspan="5">Module 5</td></tr>
<tr><td>9 a)</td><td>Three types of fertilizers are used on three groups of plants for 5 weeks. Examine whether there is a difference in the mean growth of each group. Using the data given below apply a one-way ANOVA test at 0.05 significant level. (Given that $F_{2,15} = 3.68$)
<table>
<tr><td>Fertilizer-1</td><td>6</td><td>8</td><td>4</td><td>5</td><td>3</td><td>4</td></tr>
<tr><td>Fertilizer-2</td><td>8</td><td>12</td><td>9</td><td>11</td><td>6</td><td>8</td></tr>
<tr><td>Fertilizer-3</td><td>13</td><td>9</td><td>11</td><td>8</td><td>7</td><td>12</td></tr>
</table></td><td>10</td><td>L4</td><td>5</td></tr>
</table>

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<tr><td>9 b)</td><td>Latin-square design experiment was conducted in respect of five fertilizers which were used on plots of different fertility.
<table>
<tr><td>A
16</td><td>B
10</td><td>C
11</td><td>D
9</td><td>E
9</td></tr>
<tr><td>E
10</td><td>C
9</td><td>A
14</td><td>B
12</td><td>D
11</td></tr>
<tr><td>B
15</td><td>D
8</td><td>E
8</td><td>C
10</td><td>A
18</td></tr>
<tr><td>D
12</td><td>E
6</td><td>B
13</td><td>A
13</td><td>C
12</td></tr>
<tr><td>C
13</td><td>A
11</td><td>D
10</td><td>E
7</td><td>B
14</td></tr>
</table>
Examine whether there is a significance difference between rows and columns at 5% significance level. (Given that $F_{4,12} = 3.26$)</td><td>10</td><td>L4</td><td>5</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>10 a)</td><td>A trial was run to check the effects of different diets. Positive numbers indicate weight loss and negative numbers indicate weight gain. Analyse whether there is an average difference in the weight of people following different diets using ANOVA Table. (Given that $F_{3,16} = 3.24$)
<table>
<tr><th>Low fat</th><th>Low calorie</th><th>Low protein</th><th>Low carbohydrate</th></tr>
<tr><td>8</td><td>2</td><td>3</td><td>2</td></tr>
<tr><td>9</td><td>4</td><td>5</td><td>2</td></tr>
<tr><td>6</td><td>3</td><td>4</td><td>-1</td></tr>
<tr><td>7</td><td>5</td><td>2</td><td>0</td></tr>
<tr><td>3</td><td>1</td><td>3</td><td>3</td></tr>
</table></td><td>10</td><td>L4</td><td>5</td></tr>
<tr><td>10 b)</td><td>Set up an analysis of variance table for the following per acre production data for three varieties of wheat, each grown on 4 plots and state if the variety differences are significant at 5% level of significance:(Given that $F_{3,6} = 4.76$ and $F_{6,2} = 19.33$)
<table>
<tr><th colspan="4">Per acre production data</th></tr>
<tr><th rowspan="2">Plot of land</th><th colspan="3">Variety of Wheat</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>1</td><td>6</td><td>5</td><td>5</td></tr>
<tr><td>2</td><td>7</td><td>5</td><td>4</td></tr>
<tr><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>4</td><td>8</td><td>7</td><td>4</td></tr>
</table></td><td>10</td><td>L4</td><td>5</td></tr>
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Paper Setter DAAC Chairman