

K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

May-June 2026		
Program: B.Tech. Scheme III		
Regular Examination: SY Semester: IV		
Course Code: CEC/ITC/AIC 401 and Course Name: AME-II / MDS		
Date of Exam: 19/05/2026	Duration: 02.5 Hours	Max. Marks: 60

Instructions:

- (1) All questions are compulsory.
- (2) Draw neat diagrams wherever applicable.
- (3) Assume suitable data, if necessary.

Q. No.	Question	Max. Marks	CO	BT level												
Q 1	Solve any two questions out of three: (05 marks each)	10														
a)	Verify Cayley Hamilton Theorem also find the matrix represented by $A^9 - 6A^8 + 10A^7 - 3A^6 + A + I$, where A is $\begin{bmatrix} 1 & 2 & 3 \\ -1 & 3 & 1 \\ 1 & 0 & 2 \end{bmatrix}$.		1	3												
b)	Find LU decomposition of matrix $A = \begin{bmatrix} 7 & 8 & 9 \\ 4 & 5 & 6 \\ 0 & 2 & 3 \end{bmatrix}$		2	3												
c)	Using the method of Lagrange's multiplier solve the following NLPP Optimise $z = x_1 + 8x_2 - x_1^2 - x_2^2$ Subject to $x_1 + x_2 = 4$, $x_1, x_2 \geq 0$		6	3												
Q 2	Solve any two questions out of three: (05 marks each)	10														
a)	The following data shows the distribution of 100 families according to their expenditure /week. The number of families corresponding to the expenditure group Rs. (10-20) and (30-40) are missing from the data. The mode of distribution is Rs. 23. Find the missing frequencies. <table border="1"><thead><tr><th>Expenditure / week</th><th>0-10</th><th>10-20</th><th>20-30</th><th>30-40</th><th>40-50</th></tr></thead><tbody><tr><td>No. Of families</td><td>14</td><td>-----</td><td>27</td><td>-----</td><td>15</td></tr></tbody></table>		Expenditure / week	0-10	10-20	20-30	30-40	40-50	No. Of families	14	-----	27	-----	15	3	3
Expenditure / week	0-10		10-20	20-30	30-40	40-50										
No. Of families	14		-----	27	-----	15										
b)	The life time of rechargeable battery follows a Weibull distribution with shape parameter 2 Given the mean is 15. Find (i)Scale Parameter, (ii) Variance, (iii) probability density function, (iv)What is the probability that battery is still functional at time $X= 12$, given that battery is functional at time $X = 7$? (v) Find the probability that component fails before 9 hours?	4	3													
c)	Ten school boys were given a test in Physics and their scores were recorded. After giving the coaching to them for 6 months again Test II was conducted. Test if the marks given below give evidence to the fact that the students are benefited by coaching. (Note:Tabular value of t at 5% LOS 9 dof: 2.262 ,10 dof: 2.228, 11 dof 2.201)	5	3													

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	<table><tr><td>Test I</td><td>70</td><td>68</td><td>56</td><td>75</td><td>80</td><td>90</td><td>68</td><td>75</td><td>56</td><td>58</td></tr><tr><td>Test II</td><td>68</td><td>70</td><td>52</td><td>73</td><td>75</td><td>78</td><td>80</td><td>92</td><td>54</td><td>55</td></tr></table>	Test I	70	68	56	75	80	90	68	75	56	58	Test II	68	70	52	73	75	78	80	92	54	55			
Test I	70	68	56	75	80	90	68	75	56	58																
Test II	68	70	52	73	75	78	80	92	54	55																
Q.3	Solve any two questions out of three. (10 marks each)	20																								
a)	(i) Determine whether following matrix A is diagonalizable, if yes find the modal matrix P and diagonal form D , where $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1 \end{bmatrix}$.	7	1	3																						
	(ii) If the matrix A is given as follows, find eigenvalues of $A^2 - 3A + A^{-1} + adj(A)$, where $= \begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & 0 \\ 0 & 1 & 4 \end{bmatrix}$.	3																								
b)	(i) Find the Singular value decomposition of the matrix, $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 0 & 0 \end{bmatrix}$	8	2	3																						
	(ii) Find the nullity of the matrix $A = \begin{bmatrix} 1 & 2 & 1 & 3 \\ 2 & 4 & 2 & 6 \\ 3 & 6 & 3 & 9 \\ 1 & 1 & 0 & 2 \end{bmatrix}$	2																								
c)	(i) Using Simplex method solve the following LPP Minimize $z = x_1 - 3x_2 + x_3$ Subject to $3x_1 - x_2 + 3x_3 \leq 7$ $2x_1 - 4x_2 \geq -12$ $-4x_1 + 3x_2 + 8x_3 \leq 10$ Where, $x_1, x_2, x_3 \geq 0$	8	6	3																						
	(ii) Convert the following LPP in the canonical form Minimize $Z = -3x_1 - 8x_2 + 2x_3$ Subject to $3x_1 - x_2 + 3x_3 \leq -7$, $2x_1 - 4x_2 \geq -12$, $-4x_1 + 3x_2 + 8x_3 = 10$, $x_1, x_2 \geq 0$	2																								
Q.4	Solve any two questions out of three. (10 marks each)	20																								

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a)	(i) Find Quartile for the for the following data:	6	3	3																					
	<table><tr><td>Salary (in Th)</td><td>20-25</td><td>25-30</td><td>30-35</td><td>35-40</td><td>40-45</td><td>45-50</td><td>50-55</td><td>55-60</td></tr><tr><td>No. Of workers</td><td>5</td><td>10</td><td>15</td><td>25</td><td>65</td><td>40</td><td>23</td><td>10</td></tr></table>	Salary (in Th)	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	No. Of workers	5	10	15	25	65	40	23	10						
	Salary (in Th)	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60																
No. Of workers	5	10	15	25	65	40	23	10																	
(ii) Find Kendall's rank correlation coefficient for the given data.	4																								
	<table><tr><td>Items</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr><tr><td>X ranks</td><td>2</td><td>7</td><td>1</td><td>5</td><td>8</td><td>10</td></tr><tr><td>Y Ranks</td><td>4</td><td>5</td><td>6</td><td>8</td><td>10</td><td>9</td></tr></table>	Items	A	B	C	D	E	F	X ranks	2	7	1	5	8	10	Y Ranks	4	5	6	8	10	9			
Items	A	B	C	D	E	F																			
X ranks	2	7	1	5	8	10																			
Y Ranks	4	5	6	8	10	9																			
b)	In a precision bombing attack, there is a 50% chance that any one bomb will strike the target. Two direct hits are required to destroy the target completely. How many bombs must be dropped to give at least 99% chances of destroying the target?	6	4	3																					
	(ii) The marks obtained by students in a college are normally distributed with mean 65 and variance 25. If 3 students are selected at random from this college what is the probability that at least one of them would have scored more than 75 marks [Note: Area under standard normal curve from z = 0 to 0.5 is 0.0228, area from 0 to 0.45 is 0.1736 , area from z = 0 to 2 is 0.4772]	4																							
c)	(i) Three training methods are tested on the performance scores.	6	5	3																					
	<table><tr><td>Method A</td><td>Method B</td><td>Method C</td></tr><tr><td>10</td><td>20</td><td>14</td></tr><tr><td>12</td><td>22</td><td>16</td></tr><tr><td>11</td><td></td><td>18</td></tr><tr><td></td><td></td><td>15</td></tr></table> Perform a One-Way ANOVA to test whether all means are equal at a 5% significance level. [Note:Table value of F distribution at DOF F(3,9),F(2,6), F(2,8),F(3,11) at LOS 0.05 are 3.2389, 5.14,, 4.26, 3.59 respectively].	Method A	Method B	Method C	10	20	14	12	22	16	11		18			15									
	Method A	Method B	Method C																						
10	20	14																							
12	22	16																							
11		18																							
		15																							
(ii) Two batches of 12 animals each are given test of inoculation. One batch was inoculated and other was not. The number dead and surviving animals are given in the following table for both cases. Can the inoculation be regarded as effective against the disease at 5% level of significance? (Note: Tabular values of χ^2 at 5% LOS and 1 dof: 3.814, 2 dof: 5.991 , 3 dof: 7.815 , 4 dof: 9.488)	4																								
	<table><tr><td></td><td>Dead</td><td>Surviving</td><td>Total</td></tr><tr><td>Inoculated</td><td>2</td><td>10</td><td>12</td></tr><tr><td>Not Inoculated</td><td>8</td><td>4</td><td>12</td></tr><tr><td>Total</td><td>10</td><td>14</td><td>24</td></tr></table>		Dead	Surviving	Total	Inoculated	2	10	12	Not Inoculated	8	4	12	Total	10	14	24								
	Dead	Surviving	Total																						
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