Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (S,FE) Examinations May 2026 (2019 Scheme)

Course Code: MET425
Course Name: QUANTITATIVE TECHNIQUES FOR ENGINEERS

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all questions, each carries 3 marks.

		Marks
1	How can an inequality constraint be written in the standard form using slack and surplus variables? Show it with an example.	(3)
2	Describe the special case of multiple optimal solutions in a Linear Programming Problem. Write an indication of the existence of such solutions.	(3)
3	Write the mathematical formulation for an assignment problem.	(3)
4	Describe the case of degeneracy in a transportation problem.	(3)
5	There are 5 jobs to be sequenced on 3 machines. Processing time matrix is available. What are the conditions that must be satisfied so that Johnson's algorithm can be applied to determine the optimal sequence?	(3)
6	What is a critical path in a network diagram? Describe the relationship between the critical path and slack (float).	(3)
7	Describe the concept of a decision tree associated with decision analysis.	(3)
8	Differentiate between a pure strategy and a mixed strategy in a game.	(3)
9	The notation M/M/5 is used to describe a queue. State what is represented by the three components of this notation.	(3)
10	Discuss the role of simulation in studying a system.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	A furniture manufacturer produces two types of tables: Dining Tables and Coffee Tables. The production involves two processes: Cutting and Assembly. The time required (in hours) for each table for each process, along with the total available hours and the profit per table, is given below. Formulate the problem as a linear programming problem and determine the optimal solution using the graphical method.	(14)

Table Type	Cutting Time (hours/unit)	Assembly Time (hours/unit)	Profit (Rs./unit)
Dining	2	4	50
Coffee	3	1	30
Available Hours	120	80	

OR

12 Solve the LPP given below using the Simplex method. (14)

Maximize $Z = 6x_1 + 11x_2$

Subject to: $2x_1 + x_2 \leq 104$

$x_1 + 2x_2 \leq 76$

$x_1, x_2 \geq 0$

Module II

13 Four sales managers A, B, C, and D are to be assigned to four cities I, II, III and IV. Each sales manager's skills and experience differ. The matrix given below shows the expected profit each manager can make when they are assigned to different cities. Determine the assignment of managers to cities so that the total profit is **maximum**. (14)

City

Sales Manager	***I***	***II***	***III***	***IV***
A	45	35	28	21
B	30	25	20	15
C	30	28	20	15
D	24	20	16	12

OR

14 A company has factories at F1, F2 and F3 that supply products to warehouses at W1, W2 and W3. The cost of shipping one item between a factory and a warehouse is given in the table below. The weekly capacities of factories and the weekly requirements of warehouses are also shown in the table. Determine the optimal transportation schedule for this company to minimise its total shipping cost. (14)

	W1	W2	W3	CAPACITY
F1	16	20	12	200
F2	14	8	18	160
F3	26	24	16	90
DEMAND	180	120	150	

Module III

15 In a machine shop, six jobs are to be processed in three machines A, B, and C in the order A-B-C. Processing times (in hours) are given in the following table. Determine the sequence for the six jobs that will minimize the total elapsed time. Also determine the total elapsed time and idle time of machines. (14)

Job/ Machine	1	2	3	4	5	6
A	8	3	7	2	5	1
B	3	4	5	2	1	6
C	8	7	6	9	10	9

OR

16 The activities and time estimate of a project are given below. Construct a network diagram for the project and determine the time required to complete the project. Also, determine the float (slack) of the individual activities. (14)

Activity	1-2	1-3	1-4	2-5	3-6	3-7	4-7	5-8	6-8	7-9	8-9
Time (days)	5	6	3	5	7	10	4	2	5	6	4

Module IV

17 An individual has four decision alternatives (A1, A2, A3 and A4) to select for investments. The market conditions are uncertain, and it can be of 5 types (M1, M2, M3, M4 and M5). The associated profit data are given in the table below. Determine the best (14)

strategies under the following decision criteria.

(i) Maximax (ii) Maximin (iii) Laplace (iii) Minimax regret

Decision Alternatives	Market Conditions				
	M1	M2	M3	M4	M5
A1	1000	4300	2350	3800	1350
A2	900	3500	5000	2500	2810
A3	4500	1550	1650	2750	1300
A4	2550	940	1500	600	750

OR

18 The table given below shows the payoff matrix for player A in a two-person game. Solve the game and determine the optimal strategies for both players A and B. Also, determine the value of the game. (14)

Player A/B	B1	B2	B3	B4
A1	2	2	3	-2
A2	4	3	2	6
A3	3	2	2	4

Module V

19 Students arrive at the library at a rate of 20 students on average in an hour. The average time taken for a student to complete the transaction is 2 minutes. There is only a single counter for all types of transactions. Assuming that the inter-arrival time and the transaction time follow exponential distributions. Calculate (14)

i) The average number of students in the system

ii) The average number of students in the queue

iii) The average time a student spends in the system

iv) The average waiting time of students in the queue

v) The average utilisation of the library counter

vi) The probability that there are no students in the system

vii) The probability that there are no students in the queue

OR

20 What are random numbers? Explain their properties and describe any one method used for random number generation. (14)

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