QUANTITATIVE DECISION MAKING
(MECH 4221)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) A situation in which a decision maker knows all of the possible outcomes of a decision and also knows the probability associated with each outcome is referred to as
(a) certainty (b) risk (c) uncertainty (d) strategy.

(ii) In case of an unbalanced problem, shipping cost coefficients of _____ are assigned to each created dummy factory or warehouse.
(a) very high positive costs (b) very high negative costs
(c) one (d) zero

(iii) The difference between the time available to do a job and the time required to do the job, is known as
(a) event (b) float (c) duration (d) constraint.

(iv) Critical path method is good for
(a) large project only (b) small project only
(c) both small and large projects equally (d) neither small nor large projects.

(v) The degeneracy in the transportation problem indicates that
(a) dummy allocation needs to be added
(b) the problem has no feasible solution
(c) the multiple optimal solutions exist.
(d) (a) and (b) only.

(vi) Which of the following method is used to obtain the initial solution of a transportation problem?
(a) Least cost method (b) Vogel's approximation method
(c) Modified distribution method (d) Both (a) and (b).

(vii) Operations Research was discovered during _____
(a) Civil War (b) World War I
(c) World War II (d) Industrial Revolution.

(viii) An assignment problem is considered as a particular case of a transportation problem because
(a) the number of rows equals columns (b) all $x_{ij} = 0$ or 1
(c) all rim conditions are 1 (d) all of the above.

(ix) The number of decision variables in the primal is equal to _____ in the dual.
(a) the number of decision variables (b) the number of constraints
(c) both (a) and (b) (d) none of the above

(x) The linear function of variables which is to be maximized or minimized is called _____
(a) Constraints (b) Objective function
(c) Basic requirements (d) None of above.

Group - B

2. (a) Dr. Thomas has been thinking about starting his own independent nursing home. The problem is to decide how large the nursing home should be. The annual returns will depend on both the sizes of the nursing home and a number of marketing factors. After a careful analysis, Dr. Thomas developed the following profitability table:

Size of nursing home	Good market	Fair market	Poor market
Small (S)	50000	20000	-10000
Medium (M)	70000	35000	-25000
Large (L)	90000	35000	-45000
Very Large (VL)	200000	25000	-120000

Indicate the decision taken on the basis of (a) Minimax Regret criterion, (b) Laplace criterion and (c) Hurwicz criteria with $\alpha = 0.8$. *[(CO1)(Apply/IOCQ)]*

(b) Name different methods useful for decision making under risk.
[(CO1)(Remember/LOCQ)]

(3 + 3 + 4) + 2 = 12

3. (a) Reduce the following game by dominance and find the game value: *[(CO2)(Apply/IOCQ)]*

		Player B			
		I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

(b) Explain the construction of a decision tree. *[(CO2)(Understand/LOCQ)]*

10 + 2 = 12

Group - C

4. (a) A project schedule has the following characteristics: *[(CO3)(Analyze/IOCQ)]*

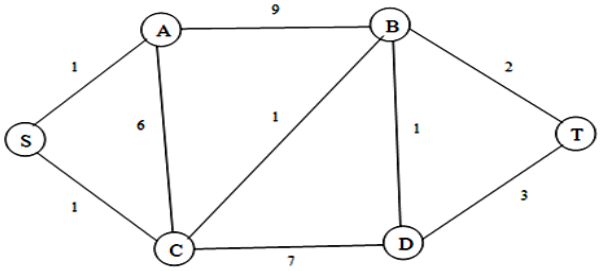
Activity	1-2	1-3	2-4	3-4	3-5	4-9	5-6	5-7	6-8	7-8	8-10	9-10
Time (weeks)	4	1	1	1	6	5	4	8	1	2	5	7

(i) Draw the activity network of the project.
(ii) Find the total float and free float for each activity.
(iii) Determine the critical path and the project duration (in weeks).

(b) Define Resource leveling process in project scheduling. *[(CO3)(Remember/LOCQ)]*

(5 + 3 + 2) + 2 = 12

5. (a) Apply Dijkstra's algorithm to find the shortest distance and shortest route from S to T in the graph given below: *[(CO3)(Apply/IOCQ)]*



(b) Discuss the Fulkerson's rule for numbering events in a network. *[(CO3)(Understand/LOCQ)]*

8 + 4 = 12

Group - D

6. (a) Find out the optimal solution to the following LPP using Simplex method

Maximize $Z = 5x_1 + 10x_2 + 8x_3$

Subject to

$3x_1 + 5x_2 + 2x_3 \leq 60$

$4x_1 + 4x_2 + 4x_3 \leq 72$

and $x_1, x_2, x_3 \geq 0$ *[(CO4)(Apply/IOCQ)]*

(b) Find the initial basic feasible solution to the following transportation problem using Vogel's approximation method: *[(CO5)(Apply/IOCQ)]*

		Destination				
		U	V	W	X	Availability
Origin	A	7	2	5	5	30
	B	4	4	6	5	15
	C	5	3	3	2	10
	D	4	-1	4	2	20
	Requirement	20	25	15	15	

7 + 5 = 12

7. (a) A company manufactures two products X_1 and X_2 on three machines A, B, and C. X_1 requires 1 hour on machine A and 1 hour on machine B and yields a revenue of Rs.3/-. Product X_2 requires 2 hours on machine A and 1 hour on machine B and 1 hour on machine C and yields revenue of Rs. 5/-. In the upcoming planning period, the available time of three machines A, B, and C are 2000 hours, 1500 hours and 600 hours respectively. Formulate LPP, such that maximum revenue can be earned by the company and also find the solution using graphical method. *[(CO4)(Create/HOCQ)]*

(b) Obtain the dual of the following linear programming problem.

Minimize $Z = 6x + 4y - 5z$

Subject to, $4x - 3y - 2z \leq 3$

$x + 2y + 3z \geq 4$

$7x - 2y + x \leq 20$

$5x - 2y - 5z \geq 3$

$3x + 5y - 2z = 3$

and $x, z \geq 0$, y unrestricted in sign *[(CO4)(Analyze/IOCQ)]*

(3 + 4) + 5 = 12

Group - E

8. (a) In the modification of a plant layout of a factory four new machines M1, M2, M3 and M4 are to be installed in a machine shop. There are five vacant places A, B, C, D and E available. Because of limited space, machine M2 cannot be placed at C and M3 cannot be placed at A. The cost of locating a machine at a place (in hundred rupees) is as follows.

		Location				
		A	B	C	D	E
Machine	1	9	11	15	10	11
	2	12	9	–	10	9
	3	–	11	14	11	7
	4	14	8	12	7	8

Find the optimal assignment schedule. *[(CO5)(Analyze/IOCQ)]*

(b) For the given function determine whether it is convex, concave or neither.

$f(X) = x_1^2 + 2x_2^2 + 3x_1x_2$ *[(CO6)(Analyze/IOCQ)]*

7 + 5 = 12

9. (a) Solve the following non-linear programming problem given below. Does the solution maximize or minimize the objective function?

Optimize $Z = x_1^2 - 10x_1 + x_2^2 - 6x_2 + x_3^2 - 4x_3$

subject to $x_1 + x_2 + x_3 = 7$

and $x_1, x_2, x_3 \geq 0$ *[(CO6)(Apply/IOCQ)]*

(b) Find the local maxima and local minima for the given function and also find the local maximum and local minimum values of the given function:

$f(x) = x^3 - 6x^2 + 9x + 15$. *[(CO6)(Analyze/IOCQ)]*

(7 + 1) + 4 = 12

Cognition Level	*LOCQ*	*IOCQ*	*HOCQ*
Percentage distribution	*10.42*	*82.29*	*7.29*

Course Outcome (CO):

At the end of the course, a student will be able to:

CO 1 Appreciate the importance of Quantitative Decision Making. Recognize different conditions and implement different decision making tool to take decisions under certain conditions.

CO 2 Solve of game theory problems and evaluate decision tree problems.

CO 3 Identify the resources required for a project and generate a plan and work schedule.

CO 4 Formulate and solve mathematical model (linear programming problem) for a physical situations like production, distribution of goods and economics.

CO 5 Analyze the problems for transporting products from origin to destination with least transportation cost and decide assignments of systems or persons in different situations.

CO 6 Formulate practical situations into non-linear programming problem

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*