QUANTITATIVE DECISION MAKING
(MECH 4221)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) If a decision theory problem has 3 decision alternatives and 4 states of nature, the number of payoffs in that problem will be
(a) 3 (b) 4 (c) 12 (d) 64

(ii) 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

(iii) Which of the following criteria is not used for decision-making under uncertainty?
(a) maximin (b) maximax
(c) minimax (d) minimize expected loss

(iv) Activity which starts only after finishing other activity is called ___.
(a) Dummy (b) Successor
(c) Predecessor (d) Null

(v) Event indicates___of activity
(a) Starting (b) Ending
(c) Both (a) & (b) (d) None of these

(vi) Simplex method of solving linear programming problem uses
(a) all the points in the feasible region
(b) only the corner points of the feasible region
(c) intermediate points within the infeasible region
(d) only the interior points in the feasible region.

(vii) The solution to a transportation problem with 'm' rows (supplies) & 'n' columns (destination) is basic feasible if number of positive allocations are
(a) m+n (b) m*n (c) m+n-1 (d) m+n+1

(viii) If at-least one of the basic variables is zero in Linear Programming Problem, then solution is said to be:
(a) Feasible solution (b) Basic Solution
(c) Degenerate basic solution (d) Non degenerate basic solution

(ix) Hungarian algorithm is used to solve
(a) Transportation problem
(b) Assignment problem
(c) Unconstrained nonlinear programming problem
(d) Constrained nonlinear programming problem

(x) While solving a Linear Programing model graphically, the area bounded by the constraints is called
(a) Feasible region (b) Infeasible region
(c) Unbounded solution (d) Non-bounded solution

Fill in the blanks with the correct word

(xi) In a LPP, the dual of a dual is _____.

(xii) In network diagrams, events are commonly represented by _____.

(xiii) The difference between the expected profit under conditions of risk and the expected profit with perfect information is called _____.

(xiv) In a Linear Programming Problem functions to be maximized or minimized are called _____ function.

(xv) An assignment problem is a particular case of _____ problem.

Group - B

2. (a) A factory manufactures three types of boxes. The fixed and variable costs are given below.

	Fixed Cost	Variable Cost
B_1	20000	10
B_2	30000	8
B_3	50000	5

The likely demands under three situations are i. Poor demand: 2000 units, ii. Moderate demand: 5000 units and iii. High demand: 10000 units. If the sale price of each type is Rs. 20, prepare the payoff table. *[(CO1)(Understand/LOCQ)]*

(b) Identify how the decision under risk is different from decision making under condition of uncertainty. *[(CO1)(Understand/LOCQ)]*

8 + 4 = 12

3. (a) A newspaper boy has the following probabilities of selling a magazine:

No. Copies Sold	10	11	12	13	14
Probability	0.10	0.15	0.20	0.25	0.30

Cost of a copy is 30 rupees and the sale price is 50 rupees. He cannot return the unsold copies. Determine how many copies should he order by following expected value criterion? *[(CO1)(Analyse/IOCQ)]*

(b) Explain EVPI. *[(CO1)(Remember/LOCQ)]*

8 + 4 = 12

Group - C

4. (a) Draw the network diagram on the basis of the following data:

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

Find the duration, critical path and total floats. *[(CO2)(Analyse/IOCQ)]*

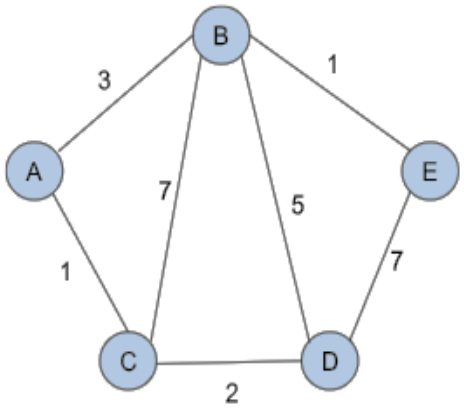
(b) The duration and immediate predecessors of activities in a small project are shown below:

Activity	A	B	C	D	E	F
Immediate Predecessor	-	-	-	A,B	B	B,C
Duration (Days)	5	3	7	8	4	5

Draw the network and calculate earliest and latest times and identify the critical path. *[(CO2)(Apply/IOCQ)]*

6 + 6 = 12

5. (a) Find the shortest path in the given weighted graph by Dijstra's algorithm.



[(CO2)(Apply/IOCQ)]

(b) A small project consists of 12 jobs as shown below.

Jobs	1-2	2-3	2-4	3-4	3-5	4-6	5-8	6-7	6-10	7-9	8-9	9-10
Duration (days)	2	7	3	3	5	3	5	8	4	4	1	7

Draw the network and mark the critical path. *[(CO2)(Apply/IOCQ)]*

6 + 6 = 12

Group - D

6. (a) Use Simplex Method to solve the following problem:

Maximize $Z = 5x + 2y + 3z$

Subject to –

$x + 2y + 2z \leq 8$

$3x + 4y + z \leq 7$

$x, y, z \geq 0$ *[(CO4)(Apply/IOCQ)]*

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

		Warehouse				Capacity
		W_1	W_2	W_3	W_4	
Factory	F_1	19	30	50	10	7
	F_2	70	30	40	60	9
	F_3	40	8	70	20	18
Requirement		5	8	7	14	34

6 + 6 = 12

7. Three grades of coal A, B and C contain phosphorus and ash as impurities. In a particular industrial process, fuel up to 100 tons (maximum) is required which should contain ash not more than 3% and phosphorus not more than 0.03%. It is desired to maximize the profit while satisfying these conditions. There is an unlimited supply of each grade. The percentage of impurities and the profits of grades are given below.

Coal	Phosphorous (%)	Ash (%)	Profits in rupees per ton
A	0.02	3.0	12.00
B	0.04	2.0	15.00
C	0.03	5.0	14.00

(i) Formulate the above as a linear programming problem (LPP).

(ii) Select a suitable method to solve the LPP and find the optimal solution using that method. *[(CO3)(Apply/IOCQ)]*

12

Group - E

8. (a) Explain concave function and convex function. Also explain local maxima, local minima, global maxima and global minima. *[(CO4)(Remember/LOCQ)]*

(b) Determine if the following function is convex, concave or neither.

$f(X) = 3x_1 + 2x_1^2 + 4x_2 + x_2^2 - 2x_1x_2$ *[(CO4)(Analyse/IOCQ)]*

6 + 6 = 12

9. (a) Determine the relative maximum and minimum (if any) of the following function.

$f(x) = x_1 + 2x_3 + x_2x_3 - x_1^2 - x_2^2 - x_3^2$ *[(CO4)(Analyse/IOCQ)]*

(b) Solve the NLPP utilizing Lagrange multiplier method.

Maximize $Z = 4x_1 - x_1^2 + 8x_2 - x_2^2$,

Subject to $x_1 + x_2 = 2$,

$x_1, x_2 \geq 0$. *[(CO4)(Evaluate/HOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	22.92	70.83	6.25