

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) 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) The value of the coefficient of optimism (a) is needed while using the criterion of
(a) Equally likely (b) Maximin (c) Realism (d) Maximax
- (iii) Essential characteristics of a decision model are
(a) States of nature (b) Decision alternatives
(c) Payoff (d) All of these
- (iv) The difference between the payoff from the best decision and the payoff from the decision actually taken is known as
(a) Expected value (b) Opportunity loss
(c) Utility (d) Risk
- (v) Activity which starts only after finishing other activity is called _____.
(a) Dummy (b) Successor (c) Predecessor (d) Null
- (vi) Burst and Merge are types of _____ in networking.
(a) Event (b) Arrow (c) Activity (d) Tools
- (vii) An activity is critical if its _____ float is zero.
(a) total (b) free (c) independent (d) interference
- (viii) 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.

- (ix) The maximum value of Z of the following LPP is $\text{Max } Z = 4x + 6y$
 Subject to
 $3x + 2y \leq 12$
 $x + y \geq 2$
 $x, y \geq 0$
 (a) 24 at (6,0) (b) 36 at (0,6) (c) 24 at (0,4) (d) 16 at (4,0)

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

Fill in the blanks with the correct word

- (xi) In a LPP, the objective function is always _____
 (xii) A transportation matrix with 8 rows and 7 columns will have _____ quantities of cells so that it does not degenerate.
 (xiii) In network diagrams, events are commonly represented by _____.
 (xiv) An activity which does not consume neither any resource nor time is known as _____ activity.
 (xv) The region that satisfies all the constraints of an LPP is called the ____ region.

Group - B

2. (a) The following matrix gives the payoff of different strategies (decision alternatives) S_1, S_2, S_3 against conditions (Events) N_1, N_2, N_3, N_4 . Indicate the decision to be taken under the following approaches:
 i. Optimistic ii. Pessimistic iii. Regret iv. Criterion of Realism v. Equal probability.

	N_1	N_2	N_3	N_4
S_1	4000	-100	6000	18000
S_2	20000	5000	400	0
S_3	20000	15000	-2000	1000

- (b) Name four Decision making Environments.

[[CO1](Analyse/IOCQ)]

[[CO1](Remember/LOCQ)]

10 + 2 = 12

3. A dairy firm wants to determine the quantity of butter it should produce to meet the demand. Past records have shown the following demand patterns:

Quantities Required	15	20	25	30	35	40	50
No. of Days	6	14	20	80	40	30	10

The stock levels are restricted to the range 15 to 50 kg due to inadequate storing facilities. Butter costs Rs. 40 per kg and is sold at Rs. 50 per kg.

- (i) Construct a conditional profit table.
 (ii) Determine the action alternative associated with maximization of expected profit.
 (iii) Determine EVPI.

[[CO1](Evaluate/HOCQ)]

(6 + 2 + 4) = 12

Group - C

4. (a) The utility data for a network are given below. Determine the total floats of each activity and identify the critical path. [[CO2)(Analyse/IOCQ]]

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration	2	8	10	6	3	3	7	5	2	8

- (b) A project schedule has the following characteristics:

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

Construct the network. Compute E and L for each event and find the critical path. [[CO2)(Analyse/IOCQ]]

$$6 + 6 = 12$$

5. (a) Construct a network representing the following project consisting of activities A,B,C,D,E,F,G,H,I and J whose durations of completion are 6, 11, 6, 3, 2, 6, 10, 7, 8 and 5 weeks respectively.

(i) Activities A, B and C are first to start simultaneously

(ii) E and D follows A, and F and G follows B and D

(iii) H follows C and F

(iv) I follows E

(v) J follows I and G

(vi) J and H are terminal activities

Construct the network diagram to compute the critical path and minimum duration of completion of the project. Do the numbering of the nodes by Fulkerson's method. Also find the total float of the activities. [[CO2)(Apply/IOCQ]]

- (b) Mention any two limitations of the critical path method. [[CO2)(Remember/LOCQ]]

$$(6 + 2 + 1 + 1) + 2 = 12$$

Group - D

6. (a) Consider the following Linear programming problem (LPP):

Maximize $w = 11x - z$

Subject to

$$10x + y - z \leq 1$$

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

$$x, y, z \geq 0$$

Write the dual of the above LPP and use the Graphical method to find the maximum value of w. [[CO4)(Apply/IOCQ]]

- (b) A simple table for a linear programming problem is given below:

	5	2	3	0	0	0	
Basic Variables	x_1	x_2	x_3	x_4	x_5	x_6	RHS
x_4	1	2	2	1	0	0	8

x_5	3	4	1	0	1	0	7
x_6	2	3	4	0	0	1	10

Find the leaving and entering variables in the next iteration of the simplex table.
 [[CO4](Apply/IOCQ)]
 $(3 + 5) + 4 = 12$

7. Find the optimal solution to the following transportation problem using the Stepping Stone Method.

Factory	Warehouse				Capacit
	W_1	W_2	W_3	W_4	
F_1	21	16	25	13	11
F_2	17	18	14	23	13
F_3	32	27	18	41	19
Requirement	6	10	12	15	43

[[CO5](Apply/IOCQ)]
12

Group - E

8. (a) Show that the following function $f(x)$ is convex by expressing it as a sum of functions of one or two variables and then proving that all the functions are convex.
 $f(x) = 5x_1 + 2x_2^2 + x_3^2 - 3x_3x_4 + 4x_4^2 + 2x_5^4 + x_5^2 + 3x_5x_6 + 6x_6^2 + 3x_6x_7 + x_7^2$
 [[CO4](Analyse/IOCQ)]
- (b) By separating the given function into three one-variable functions, show that the function is convex. Also find the minimum value of the function by solving each one-variable function by calculus.
 $Z = 2x_1^2 - 24x_1 + 2x_2^2 - 8x_2 + 2x_3^2 - 12x_3 + 200$
 [[CO4](Analyse/IOCQ)]
 $6 + 6 = 12$
9. (a) Write a short note on the assignment problem and its applications. [[CO6](Understand/LOCQ)]
 (b) Solve the following assignment problem. The matrix entries are processing times in hours.

Operator

		1	2	3	4	5
Job	1	20	22	35	22	18
	2	4	26	24	24	7
	3	23	14	17	19	19
	4	17	15	16	18	15
	5	16	19	21	19	25

[[CO6](Apply/IOCQ)]
 $4 + 8 = 12$

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	8.33	79.17	12.50