QUANTITATIVE DECISION MAKING
(MECH 4181)

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) In a project logic, four activities M, N, 0 and P are to be completed before starting activity Q. If the finish times of M, N, 0 and P are 12-00 hr, 14-00 hr, 15-00 hr. and 17-00 hr. respectively, the earliest event occurrence time for the activity
(a) 1200 hr. (b) 1400 hr. (c) 1500 hr. (d) 1700 hr.

(ii) Dijkstra's Algorithm cannot be applied on
(a) Directed and weighted graphs
(b) Graphs having negative weight function
(c) Unweighted graphs
(d) Undirected and unweighted graphs.

(iii) What does Maximum flow problem involve?
(a) Finding a flow between source and sink that is maximum
(b) Finding a flow between source and sink that is minimum
(c) Finding the shortest path between source and sink
(d) Computing a minimum spanning tree

(iv) This innovative science of Operations Research was discovered during
(a) Civil War (b) World War I
(c) World War II (d) Industrial Revolution.

(v) Which of the following is a method for improving an initial solution in a transportation problem?
(a) Northwest-corner (b) Lowest-cost
(c) Vogel's approximation (d) Stepping-stone.

(vi) When the total supply is not equal to total demand in a transportation problem then it is called
(a) Balanced (b) Unbalanced (c) Degenerate (d) None of these.

(vii) In graphical representation the bounded region is known as _____ region
(a) solution (b) basic solution
(c) feasible solution (d) optimal.

(viii) The solution to a transportation problem with m-rows and n-columns is feasible if number of positive allocations are
(a) m + n (b) m *n (c) m+n-l (d) m+n+l.

(ix) In Degenerate solution value of objective function
(a) increases infinitely (b) basic variables are nonzero
(c) decreases infinitely (d) one or more basic variables are zero.

(x) For a maximization problem, objective function coefficient for an artificial variable is
(a) +M (b) -M (c) Zero (d) None of these.

Group – B

2. (a) A television dealer finds that the cost of a TV in stock for a week is Rs. 30 and the cost of a unit shortage is Rs.70. For one model of TV the probability distribution of weekly sales is as follows:

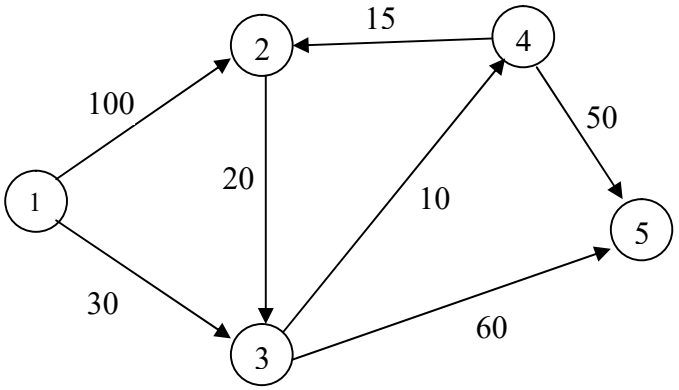
Weekly sales	0	1	2	3	4	5	6
Probability	0.1	0.1	0.2	0.25	0.15	0.15	0.05

How many units per week should the dealer order? Also find Expected Value of Perfect Information.

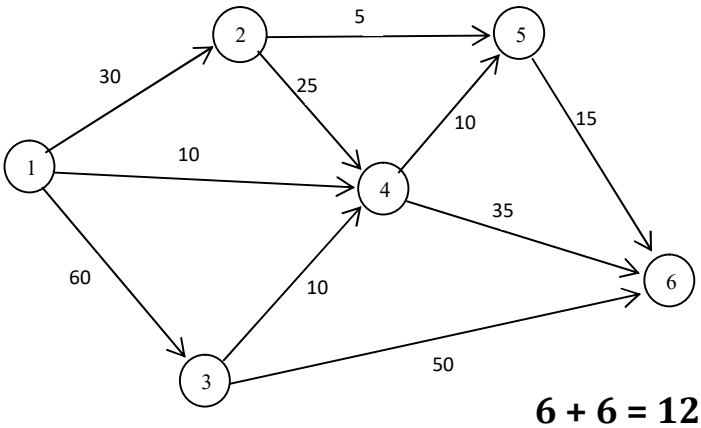
(b) Explain the different methods useful for decision making under uncertainty.

8 + 4 = 12

3. (a) The network shown in figure on the right gives the permissible route and their length in kilometres between city 1 (node 1) to four other cities (nodes 2 to 5). Apply Dijkstra's algorithm to determine the shortest route and shortest distance from city 1 to city 5.



(b) Determine the maximal flow from source (1) to sink (6), for the network given in figure on the right.



6 + 6 = 12

Group – C

4. (a) On completing the construction of a house a person discovers that 100 square feet of plywood scrap and 80 square feet of white pine scrap are in usable form for the construction of tables and book cases. It takes 16 square feet of plywood and 8 square feet of white pine to make a table; 12 square feet of plywood and 16 square feet of white pine are required to construct a book case. By selling the finished product to a local furniture store the person can realize a profit of ₹ 250 on each table and ₹ 290 on each book case. How may the person most profitably use the left-over wood? Formulate the problem as a linear programming model and use graphical method to solve the problem.

(b) Obtain the dual of the following linear programming problem.
Maximize $Z = 6x + 4y - 5z$
Subject to, $5x - 6y - z \leq 3$
$-x + y + 3z \geq 4$
$8x - 2y + x \leq 10$
$x - 2y - 5z \geq 3$
$4x + 9y - 2z = 2$
and $x, y, z \geq 0$

(3 + 4) + 5 = 12

5. (a) Find the optimal solution of the LPP by Simplex method:
Minimize $Z = 8X_1 + 5X_2$
Subject to constraints,
$20X_1 + 12X_2 \geq 200$
$8X_1 \geq 40$
$6X_2 \geq 30$
$X_1, X_2 \geq 0$

(b) A production control superintendent finds the following information on his desk. In departments A. B and C, the number of surplus pallets is 18. 27 and 21 respectively. In departments G, H, I and the number of pallets required is 14, 12, 23 and 17 respectively. The time in minutes to move a pallet from one department to another is given below:

		To			
		G	H	I	J
From	A	13	25	12	21
	B	18	23	14	9
	C	23	15	12	16

What is the optimal distribution plan to minimize the moving time?

7 + 5 = 12

Group – D

6. (a) Five different machines can do any of the five required jobs, with different profit resulting from each assignment. Find the assignment that maximizes the total profit.

		Machines				
		A	B	C	D	E
Jobs	1	30	37	40	28	40
	2	40	24	27	21	36
	3	40	32	33	30	35
	4	25	38	40	36	36
	5	29	62	40	34	39

(b) The following table gives the activities in a construction project and the time duration:

Activity	1-2	1-3	2-3	2-4	3-4	4-5
Preceding activity	-	-	1-2	1-2	1-3,2-3	2-4,3-4
Normal time (days)	20	25	10	12	5	10

(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.

7 + 5 = 12

7. (a) The following table gives the activities in a construction project and other relevant information:

Activity	**Immediate predecessor**	**Time (days)**		**Direct cost (Rs.)**	
		Normal	**Crash**	**Normal**	**Crash**
A	-	4	3	60	90
B	-	6	4	150	250
C	-	2	1	38	60
D	A	5	3	150	250
E	C	2	2	100	100
F	A	7	5	115	175
G	D,B,E	4	2	100	240

If the indirect cost is Rs.100/day, find the project duration which will result in minimum total cost.

(b) Define Project Crashing in Network model.

10 + 2 = 12

Group – E

8. Use the method of Lagrangian multipliers to solve the following NLPP. Does the solution maximize or minimize the objective function?

Optimize $Z = 4x_1 + 2x_2^2 + x_3^2 - 4x_1x_2$
subject to $x_1 + x_2 + x_3 = 15$
$2x_1 - x_2 + 2x_3 = 20$
and $x_1, x_2, x_3 \geq 0$

12

9. (a) Write the Kuhn-Tucker conditions for the following problems and obtain the optimal solution.

Maximize $Z = 2x_1 + 3x_2 - x_1^2 - 2x_2^2$

subject to $x_1 + 3x_2 \leq 6$

$5x_1 + 2x_2 \leq 10$

and $x_1, x_2 \geq 0$

(b) Determine the relative maximum and minimum (if any) of the following function:

$f(X) = x_1^2 + 2x_2^2 + x_3^2 + x_1x_2 - 2x_2 - 7x_1 + 12$

(2 + 5) + 5 = 12

Department & Section	Submission link:
CE	https://classroom.google.com/c/MTUxNjQxOTM1NTAw/a/Mjc0NDk1OTE4NjA0/details