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) The term commonly used for activity slack time is
(a) total float (b) independent float
(c) free float (d) all of the above.

(ii) The value of coefficient of optimism (α) is needed while using the criterion of
(a) Maximin (b) Realism
(c) Equally likely (d) Minimax.

(iii) The expected value of perfect information (EVPI) is equal to
(a) Expected regret of optimal decision under risk
(b) Maximum opportunity loss
(c) The utility of additional information
(d) Expected.

(iv) A feasible solution of LPP
(a) must satisfy all the constraints simultaneously
(b) need not satisfy all the constraints, only some of them
(c) must be a corner point of the feasible region
(d) all of the above.

(v) Among all possible 'cuts' of flow in a network, the minimal cut capacity corresponds to
(a) no network flow (b) minimal network flow
(c) maximal network flow (d) any network flow.

(vi) Network models are used for project_____.
(a) planning (b) controlling
(c) scheduling (d) all of the above.

(vii) Which of the following is correct?
(a) Hirwicz criterion is based on the principle of insufficient reason
(b) EPPI is expected pay-off under certainty
(c) Laplace criterion converts a 'problem under certainty' into a 'problem under certainty'
(d) EVPI is the expected regret value of any strategy.

(viii) Out of the following methods, _____ is a method to obtain initial solution to Transportation Problem.
(a) Northwest-corner (b) stepping-stone
(c) southeast-corner rule (d) MODI.

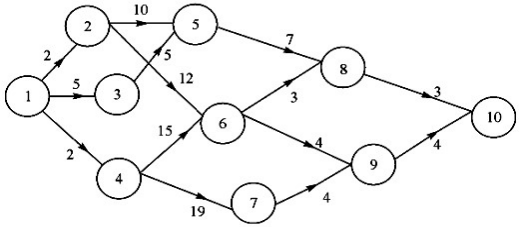
(ix) CPM is
(a) probabilistic (b) deterministic
(c) event oriented (d) all of the above.

(x) The method used for solving an assignment problem is called
(a) Reduced matrix method (b) Hungarian method
(c) MODI method (d) none of the above.

Group – B

2. (a) A modern home appliances dealer finds that the cost of holding a mini cooking range in stock for a month is Rs.200 (insurance, minor deterioration, interest on borrowed capital etc). Customer who cannot obtain a cooking range immediately tends to go to the other dealers and he estimates that for every customer who cannot get immediate delivery, he loses an average of Rs.500. The probabilities of a demand of 0, 1, 2, 3, 4, 5 mini cooking ranges in a month are 0.05, 0.10, 0.20, 0.30 0.20, 0.15 respectively. Determine the optimum stock level of cooking ranges. Also find EVPI.

(b) Mr. Banerjee, a sales manager, has decided to travel from city 1 to city 10. He wants to plan for minimum distance programme and visit maximum number of branch offices possible on the route. The route map of the various ways of reaching city 10 from city 1 is shown below. The numbers on the arrow indicates the distance in km (× 100). Suggest a feasible minimum path plan to Mr. Banerjee.



7 + 5 = 12

3. (a) The oil India corporation is considering whether to go for an offshore oil drilling contract to be awarded in Mumbai high. If they bid, cost would be Rs.600 million with a 65% chance of gaining the contract. They may need to set up a drilling operation at new site or move already existing operation set up, which has been proved to be successful, to new site. The probability of success an expected returns are as follows:

Outcome	New Drilling Operation		Existing Operation	
	Probability	Expected revenue Rs. (million)	Probability	Expected revenue Rs. (million)
Success	0.75	800	0.85	700
Failure	0.25	200	0.15	350

If the corporation do not bid or lose the contract or fail, they can use the Rs.600 million to modernize their operation. This would result in a return of either 5% or 8% on the sum invested with probabilities 0.45 and 0.55 (Assume that all costs and revenues have been discounted to present value).

(i) Construct a decision tree for the problem showing clearly the courses of action,

(ii) By applying an appropriate decision criterion, recommend whether or not the Oil Indian Corporation should bid the contract.

(b) Consider the details of a distance network as shown below:

Arc	Distances	Arc	Distances	Arc	Distances	Arc	Distances
1-2	6	3-4	6	5-6	13	6-10	3
1-3	7	3-5	11	5-8	9	7-9	10
1-4	10	3-6	3	6-7	5	8-10	10
2-3	8	3-7	5	6-8	4	9-10	9
2-5	4	4-7	7	6-9	8		

(i) Construct the distance network

(ii) Find the minimum spanning tree using PRIM's algorithm.

7 + 5 = 12

Group – C

4. (a) In a chemical industry, two products A and B are made involving two operations. The production of B results also in a by-product C. The product A can be sold at a profit of Rs. 30 per unit and B at Rs. 80 per unit. The by - product C sells at a profit of Rs. 20 per unit but if it is not sold, it should be destroyed at a destruction cost of Rs. 10 per unit. Forecast show that up to 5 units of C can be sold. The company gets 3 unit of C for each unit of B produced. The manufacturing times are 3

hours and 4 hours per unit for A on operation one and two respectively and 4 hours and 5 hours per unit for B on operation one and two respectively. Because product C results from producing B, no time is spent in producing C. The available times are 18 and 21 hours of operation one and two respectively. Formulate the problem as a linear programming model.

(b) Find the initial basic feasible solution of the following transportation problem by Vogel's Approximation Method (VAM):

Plant \ Warehouse	W1	W2	W3	Supply
P1	4	3	2	10
P2	2	5	0	13
P3	3	8	6	12
Demand	8	5	4	

6 + 6 = 12

5. (a) Find the optimal solution of the LPP by Simplex method:
Maximize Z = 13X + 11Y
Subject to constraints,
$4X + 5Y \leq 1500$
$5X + 3Y \leq 1575$
$X + 2Y \leq 420$
Where $X,Y \geq 0$

(b) Find the initial basic feasible solution (BFS) of the following transportation problem by Vogel's Approximation Method (VAM):

Plant \ Warehouse	W_1	W_2	W_3	W_4	Supply
P_1	5	1	3	3	34
P_2	3	3	5	4	15
P_3	6	4	4	3	12
P_4	4	1	4	2	19
Demand	21	25	17	17	

6 + 6 = 12

Group – D

6. (a) An airline company has drawn up a new flight schedule that involves five flights. To assist in allocating five pilots to the flights, it has asked them to state their preference scores by giving each flight a number

out of 10. The higher the number, the greater is the preference. A few of these flights are unsuitable to same pilots, owing to domestic reasons. These have been marked with 'X'.

	Flight Number				
Pilot	1	2	3	4	5
A	8	2	X	5	4
B	10	9	2	8	4
C	5	4	9	6	X
D	3	6	2	8	7
E	5	6	10	4	3

What should be the allocation of the pilots to flights in order to meet as many preferences as possible?

(b) For a standard normal variable Z, $P(0 \le z \le 1) = 0.4313$, if the expected duration of a project is 40 days and the standard deviation of the critical path is 5 days, what is the probability of completing the project in 35 days?

(c) What is the purpose of introducing a dummy activity in a network?

7 + 3 + 2 = 12

7. (a) Write down the steps involved in project crashing.

(b) A small maintenance project consists of the following jobs whose activity relationships are given below

Jobs	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration (Days)	15	15	03	05	08	12	01	14	03	14

(i) Draw the network diagram of the project
(ii) Find the total float of each activity
Find the critical path and total project duration.

4 + 8 = 12

Group – E

8. Obtain the solution of the following problem using Lagrangian multipliers
Minimize $Z = 4x_1^2 + 2x_2^2 + x_3^2 + 4x_1x_2$
Subject to, $x_1 + x_2 + x_3 = 15$, $2x_1 - x_2 + 2x_3 = 20$ and $x_1, x_2, x_3 \ge 0$

12

9. (a) Solve the following non-linear programming problem graphically,
Maximize $Z = x_1 + 2x_2$ subject to $x_1^2 + x_2^2 \le 1$, $2x_1 + x_2 \le 2$ and $x_1, x_2 \ge 0$

(b) Use Wolf's method to solve the quadratic programming problem:
Maximize $Z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$.

5 + 7 = 12