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) Operations Research has the characteristics that is done by a team of
(a) Scientists (b) Mathematicians
(c) Managers (d) All of the above.

(ii) Programme evaluation and review technique (PERT) is
(a) Probabilistic (b) Deterministic
(c) Both (a) and (b) (d) Optimistic.

(iii) Network models are used for project _____
(a) planning (b) scheduling
(c) controlling (d) All of the above.

(iv) One can find the initial basic feasible solution by using _____
(a) VAM (b) MODI (c) Optimality test (d) Steeping Stone.

(v) If in a LPP , the solution of a variable can be made infinitely large without violating the constraints, the solution is
(a) Infeasible (b) Unbounded
(c) Alternative (d) None of the above.

(vi) Graphical method can be applied to solve a LPP when there are only _____ variable
(a) One (b) More than three (c) Two (d) Three.

(vii) If there are more than one optimum solution for the decision variable the solution is _____
(a) Infeasible (b) Unbounded
(c) Alternative (d) None of the above.

(viii) Lagrangian conditions are used to solve_____ problems
(a) Integer linear programming (b) Linear programming
(c) Non linear programming (d) Dynamic programming.

(ix) Which variables are fictitious and cannot have any physical meaning?
(a) Basic Variables (b) Decision variables
(c) Artificial variables (d) Slack variables.

(x) The term commonly used for activity slack time is
(a) Total float (b) Free float
(c) Independent float (d) All of the above.

Group - B

2. (a) Demand for a seasonal product is as given below:

Demand during the season	40	45	50	55	60	65
Probability	0.10	0.20	0.30	0.25	0.10	0.05

The product cost Rs. 60 per unit and sells at Rs. 80 per unit. If the units are not sold within the season. They will have no market value.
i) Prepare a pay off and regret table
ii) Find the expected pay offs and regrets.
iii)Find the optimum quantity to be produced and EVPI

(b) A company is going to develop a new product in the market. Three alternative decisions are available for the management.
A_1 : Advertising on television, where advertising cost is Rs. 3500.
A_2 : Appointing salesman for marketing. The cost is Rs. 1250.
A_3 : conducting an exhibition, where cost is Rs. 950.
The unit selling price is fixed at Rs. 35 and the costs of manufacturing per unit associated with the respective decision alternatives are 12, 8 and 15. The expected demand for the product is as follows.

Demand :	200	300	400	500
Probability :	0.3	0.2	0.4	0.1

The company has to decide upon the best alternative among the three decisions.

6 + 6 = 12

3. (a) Consider the details of a distance network as shown below

Arc	Distances	Arc	Distances	Arc	Distances
1-2	8	2-7	4	6-8	9
1-3	5	3-4	5	6-9	15
1-4	7	3-6	6	7-9	12
1-5	16	4-5	8	8-9	6
2-3	15	4-6	12		
2-6	3	5-8	7		

i) Construct the distance network
ii) Find the shortest path from node 1 to node 9 using the systematic method.

(b) Consider the pipe network shown in fig. 1 showing the flow capacities between various pairs of locations in both ways. Find the maximal flow from the node 1 to node 6.

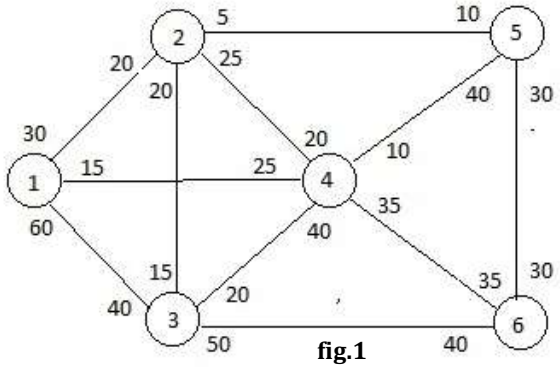

fig.1

(3 + 3) + 6 = 12

Group - C

4. (a) Solve the L.P.P. by graphical method:

Minimize $Z = 1.5x_1 + 2.5x_2$

Subject to constraints: $x_1 + 3x_2 \geq 3$

$x_1 + x_2 \geq 2$ where $x_1, x_2 \geq 0$

(b) Find the optimal solution of the LPP by Simplex method:

Maximize $Z = 3x_1 + 2x_2$

Subject to constraints: $x_1 - x_2 \leq 1$

$x_1 + 2x_2 \leq 3$ where $x_1, x_2 \geq 0$

4 + 8 = 12

5. (a) What is a Basic Feasible Solution in Linear Programming? How is it different from a feasible solution in linear programming?

(b) An organization is interested in the analysis of two products which can be produced from the available time of labour, machine and by product. It was notified on investigation that the labour requirement of the first and the second products was 4 and 5 units respectively and the total available man hours was 48. Only first product required machine hour utilization of one hour per unit and at present only 10 spare machine hours are available. Second product needs one unit of by product per unit and the daily availability of the by product is 12 units. According to the marketing department the sales potential of first product cannot exceed 7 units. In a competitive market, first product can be sold at a profit of Rs.6 and the second product at a profit of Rs.10 per unit. Formulate the problem as a linear programming model.

(c) Find the initial basic feasible solution of the following transportation problem by North West Corner Rule and Minimum Cost Method and find out which one gives better result.

Warehouse / Plant	W_1	W_2	W_3	Supply
P_1	7	6	9	20
P_2	5	7	3	28
P_3	4	5	8	17
Demand	21	25	19	

(1 + 1) + 4 + 6 = 12

Group - D

6. (a) In the modification of a plant layout of a factory, four new machines M_1, M_2, M_3 and M_4 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 M_2 cannot be placed at C and M_3 cannot be placed at A. The cost of placing of machines at different places (in hundred rupees) is shown in table below:

	A	B	C	D	E
M_1	9	11	15	10	11
M_2	12	9	---	10	9
M_3	---	11	14	11	7
M_4	14	8	12	7	8

Find the optimal assignment schedule.

(b) What is crashing of networks? What are the costs involved in network crashing and explain.

6 + (2 + 4) = 12

7. (a) Explain optimistic time, pessimistic time and most likely time of project activities.

   (b) The following table gives the activities in a construction project and other related information:

Activity	**:**	**1-2**	**1-3**	**2-3**	**2-4**	**3-4**	**4-5**
Optimistic time (days) t_0	:	20	9	3	2	1	12
Most likely time t_m	:	30	12	5	3	2	18
Pessimistic time t_p	:	46	21	7	4	3	24

   i) Draw a PERT diagram
   ii) Calculate total project duration
   iii) Mark critical path
   iv) Find the probability that the project will be completed in 50 days.

3 + 9 = 12

Group - E

8. Solve the following nonlinear programming problem using the method of lagrangian multiplier.

   Minimize $Z = X_1^2 + X_2^2 + X_3^2$
   Subject to the constraints $X_1 + X_2 + 3X_3 = 2$
   $5X_1 + 2X_2 + X_3 = 5$ and $X_1, X_2 \geq 0$ 12

12

9. Use Wolfe's method to solve following problem:

   Maximize $Z = 2X + Y - X^2$
   Subject to constraints $2X + 3Y \leq 6$
   $2X + Y \leq 4$ and $X, Y \geq 0$ 12

12