(b) A small maintenance project consists of the following jobs, whose precedence relationships and durations are given below:

Job	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration (days)	15	15	3	5	8	12	1	14	3	14

(i) Draw an arrow diagram representing the project.
(ii) Find the critical path and the minimum project duration.

7 + 5 = 12

7. (a) The following table gives optimistic time (a), the most likely time (m) and the pessimistic time (b). Draw the network of the project and calculate the slack for each event. Find the critical path and the expected duration of the project. Also find the standard deviation.

Activity	1-2	1-3	2-5	3-4	4-5	5-8	4-6	4-7	6-9	8-9	7-10	9-10
a	3	1	6	8	0	5	6	3	1	3	8	2
m	5	2	8	12	0	7	9	6	2	5	15	5
b	7	3	12	17	0	9	12	8	3	8	20	6

(b) Define critical activity and critical path.

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 $Z = x_1^2 + x_2^2 + x_3^2$
subject to $x_1 + x_2 + 3x_3 = 2$
$5x_1 + 2x_2 + 3x_3 = 5$
and $x_1, x_2, x_3 \geq 0$

12

9. (a) Solve the following non-linear programming problem graphically,
Maximize $Z = 10x_1 - x_1^2 + 10x_2 - x_2^2$
subject to constraints $x_1 + x_2 \leq 12$,
$x_1 + x_2 \leq 6$
and $x_1, x_2 \geq 0$

(b) Determine the relative maximum and minimum (if any) of the following function:
$f(X) = x_1 + 2x_3 + x_2x_3 - x_1^2 - x_2^2 - x_3^2$

6 + 6 = 12

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 constructing a network, forward pass computations are done for determining
(a) Earliest event time (b) Latest allowable time
(c) Floats and slack times (d) none of these.

(ii) In PERT the span of times between the optimistic and pessimistic time estimates of an activity is
(a) 3σ (b) 6σ (c) 12σ (d) σ.

(iii) Critical path method is
(a) Probabilistic (b) deterministic
(c) both (a) and (b) (d) none of (a), (b) & (c).

(iv) The distinguishing feature of an LP model is
(a) Relationship among all variables is linear
(b) It has single objective function & constraints
(c) Value of decision variables is non-negative
(d) All of the above.

(v) Which of the following is not a characteristic of the LP model
(a) Alternative courses of action
(b) An objective function of maximization type
(c) Limited amount of resources
(d) Non-negativity condition on the value of decision variables.

(vi) An iso-profit line represents
(a) An infinite number of solutions all of which yield the same profit
(b) An infinite number of solution all of which yield the same cost
(c) An infinite number of optimal solutions
(d) A boundary of the feasible region.

(vii) Which of the following methods is used to verify the optimality of the current solution of the transportation problem
(a) Least cost method
(b) Vogel's approximation method
(c) Modified distribution method
(d) All of the above.

(viii) Laplace criteria is applicable for decision making under
(a) certainty (b) Uncertainty
(c) risk (d) none of (a), (b) & (c).

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

(x) An assignment problem can be solved by
(a) Simplex method (b) Transportation method
(c) Both a & b (d) none of (a), (b) & (c).

Group – B

2. (a) The following matrix gives the payoff (in Rs) of different strategies (alternatives) S_1, S_2, AND S_3 against conditions (events) N_1, N_2, N_3 and N_4.

Strategy	State of Nature			
	N1	N2	N3	N4
S1	4000	-100	6000	18000
S2	20000	5000	400	0
S3	20000	15000	-2000	1000

Indicate the decision taken under the following approaches:
(i) Pessimistic
(ii) Optimistic
(iii) Laplace criterion
(iv) Regret criterion
(v) Hurwicz criterion, the degree of optimism being 0.7.

(b) What is an "Opportunity loss table"

10 + 2 = 12

3. (a) The manager of a flower shop promises its customers delivery within four hours on all flower orders. All flowers are purchased on the previous day and delivered to manager by 8.00 am the next morning. The daily demand for roses is as follows.

Dozens of roses	70	80	90	100
Probability	0.1	0.2	0.4	0.3

The manager purchases roses for Rs. 10 per dozen and sells them for Rs. 30. All unsold roses are donated to a local hospital. How many dozens of roses should manager order each evening to maximize its profits? What is the optimum expected profit?

(b) What are the types of decision-making situations?

9 + 3 = 12

Group – C

4. (a) Solve the L.P.P. by graphical method:
Maximize $Z = 50X + 30Y$
Subject to constraints,
$2X + Y \geq 18$
$X + Y \geq 12$
$3X + 2Y \leq 34$
Where $X, Y \geq 0$

(b) Find the optimal solution of the LPP by Simplex method:
Maximize $Z = x_1 + x_2 + 3x_3$
Subject to constraints $3x_1 + 2x_2 + x_3 \leq 3$
$2x_1 + x_2 + 2x_3 \leq 2$
$x_1, x_2, x_3 \geq 0$

5 + 7 = 12

5. (a) Find the optimal solution of the LPP by Simplex method:
Maximize $Z = 10X_1 + 6X_2 + 4X_3$
Subject to constraints,
$X_1 + X_2 + X_3 \leq 100$
$10X_1 + 4X_2 + 5X_3 \leq 600$
$2X_1 + 2X_2 + 6X_3 \leq 300$
Where $X_1, X_2, X_3 \geq 0$

(b) Solve the following transportation problem by Vogel's approximation method.

Warehouse / Plant	W1	W2	W3	W4	Supply
P1	19	30	50	12	7
P2	70	30	40	60	10
P3	40	10	60	20	18
Demand	5	8	7	15	

5 + 7 =12

Group – D

6. (a) A marketing manager has five salesmen and five sales districts. Considering the capabilities of the salesmen and the nature of districts, the marketing manager estimates that the sales per month (in hundred rupees) for each salesman in each district would be as follows:

		Districts				
		A	B	C	D	E
Salesmen	1	32	38	40	28	40
	2	40	24	28	21	36
	3	41	27	33	30	37
	4	22	38	41	36	36
	5	29	33	40	35	39

Find the assignment of salesman to districts that will result in maximum sales.