M.TECH/CSE/2ND SEM/CSEN 5226/2015
2015

Operational Research and Optimization Techniques
(CSEN 5226)

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 x 1=10**

(i) The optimal solution of a LP problem exists on the extreme points if the solution region is

(a) convex (b) concave
(c) both convex and concave (d) none of the above.

(ii) In the Branch and Bound approach to a maximization integer LPP, a node is terminated if

(a) a node has an infeasible solution
(b) a node yields a solution that is feasible but not an integer
(c) upper bound is less than the current sub-problem's lower bound
(d) all of the above.

(iii) The simplex method is terminated for maximization LP model, when:

(a) $z_j - c_j \geq 0$ (b) $z_j - c_j \leq 0$
(c) $z_j - c_j = 0$ (d) $z_j \geq 0$.

(iv) For a minimization LP, the objective function coefficient for an artificial variable is

(a) + M (b) - M
(c) Zero (d) none of the above.

(v) Let $S = \{(x_1, x_2): x_1^2 + x_2^2 \leq 1\}$. Then S has

(a) no vertex (b) finite number of vertices
(c) infinite number of vertices (d) none of the above.

(vi) The function $f(X) = 3x_1^2 - 2x_2^2 + x_3^2$ is

(a) positive definite (b) positive semi-definite
(c) negative definite (d) indefinite.

(vii) Which of the following is not deterministic model?

(a) Linear programming problem (b) Transportation problem
(c) CPM (d) PERT.

(viii) Branch and Bound method divides the feasible solution space into smaller parts by
(a) branching (b) bounding
(c) enumerating (d) all of the above.

(ix) If an activity has zero slack, it implies that
(a) it lies on the critical path (b) it is a dummy activity
(c) the project is progressing well (d) none of the above.

(x) The return function in a dynamic programming model depends on
(a) stages (b) states
(c) alternatives (d) all of the above.

Group – B

2. Solve the following LPP by simplex method

$$\text{Min } z = x_1 - 2x_2 + x_3$$
$$\text{s.t. } x_1 + 2x_2 - 2x_3 \le 4$$
$$x_1 - x_3 \le 3$$
$$2x_1 - x_2 + 2x_3 \le 2$$
$$x_1, x_2, x_3 \ge 0$$

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3.(a) Let $B = \{X_1, X_2, \ldots, X_n\}$ be a basis in a linear space R^n and let $X \notin B$ such that $X = a_1X_1 + a_2X_2 + \ldots + a_nX_n$. If $a_i = 0$ then X_i cannot be replaced by X to form a new basis of R^n.

(b) Show that the following LPP has unbounded solution

$$\text{Max } z = 4x_1 + x_2$$
$$\text{s.t. } x_1 - x_2 \le 1$$
$$-2x_1 + x_2 \le 2$$
$$x_1, x_2 \ge 0$$

6+6=12

Group – C

4. A manufacturer of baby dolls makes two types of doll (e.g., Sita and Gita). These dolls are processed in two type of machines – A (available 1 no.) and B (available 2 nos.). e The processing time for each 'Sita' is 2 hours and 6 hours on machines A and B respectively and that for each 'Gita' is 5 hours and 5 hours on machines A and B respectively. There is 16 hours of time available per day on machine A and 30 hours on machine B(2 nos.). The profit contribution from a 'Sita' is Rs 6 and that from a 'Gita' is Rs 18. Formulate and solve this problem (using brunch and bound method) as an integer linear programming problem to determine the optimal schedule of the two dolls. Use graphical method to solve the LPs.

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5. Find the sequence that minimizes the total time required in performing the following jobs on three machines in the order ABC. Also calculate the idle times for each machine. Processing times (in hours) are given in the following table:

Job:	1	2	3	4	5	6	7
Machine A:	3	8	7	4	9	8	7
Machine B:	4	3	2	5	1	4	3
Machine C:	6	7	5	11	5	6	12

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Group – D

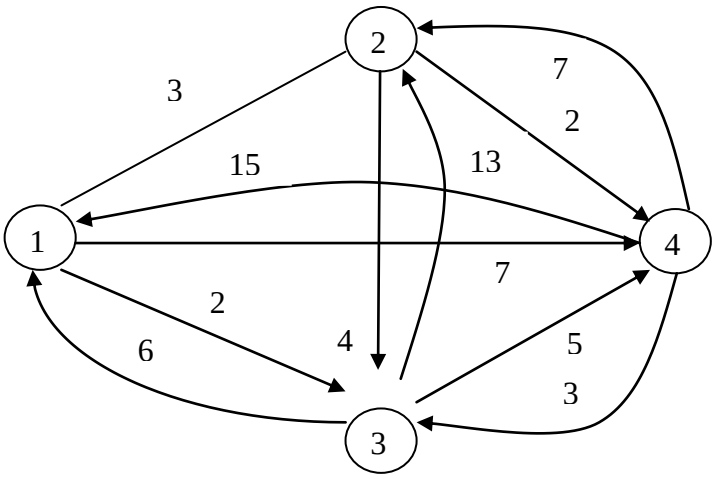
6. An organization is considering a new system for automatic inventory control. A vendor sent the information about the system installation:

Activity	Immediate Predecessor	Times (days)		
		Optimistic	Most Likely	Pessimistic
A	-	4	6	8
B	A	5	7	15
C	A	4	8	12
D	B	15	20	25
E	B	10	18	26
F	C	8	9	16
G	E	4	8	12
H	D, F	1	2	3
I	G, H	6	7	8

(a) Construct the network diagram for the project.
(b) Determine the critical path and compute the expected completion time.
(c) Determine the probability of completing the project in 55 days.
(Given that $P(Z \leq 2.29) = 0.9634$.)

5+4+3=12

7. Solve TSP for which the costs between city pairs are given as



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Group – E

8. Use the Lagrange multiplier method to solve the following NLPP. Does the solution maximizes or minimizes the objective function?

$$\text{opt } f(X) = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1x_2$$
$$\text{s.t. } x_1 + x_2 + x_3 = 15$$
$$2x_1 - x_2 + 2x_3 = 20$$
$$x_1, x_2, x_3 \geq 0$$

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9. Use dynamic programming to show that $p_1 \log p_1 + p_2 \log p_2 + ... + p_n \log p_n$ subject to the constraint $p_1 + p_2 + ... + p_n = 1$ and $p_i \geq 0$ for all i, is minimum when $p_1 = p_2 = ... = p_n = 1/n$.

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