Reg. No.



SEVENTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.) END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: OPERATIONS RESEARCH [ICE 453]

Time: 3 Hours

MAX. MARKS: 50

2

3

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2

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Instructions to Candidates: Answer ANY FIVE FULL questions. Missing data may be suitably assumed.

- 1A. An animal feed company must produce 200kg of a mixture consisting of ingredients x1 and x2. The ingredients x1 costs Rs. 3 per kg and x2 costs Rs. 5 per kg. No more than 80kg of x1 can be used and at least 60kg of x2 must be used. Formulate the model to minimize the cost of the mixture.
- **1B.** Solve the problem using graphical method.
- $x_1, x_2 \ge 0$ **1C.** Solve the following problem using big M method
 - Maximize $Z = 6x_1 3x_2 + 2x_3$ Subject to $2x_1 + x_2 + x_3 \le 16$ $3x_1 + 2x_2 + x_3 \le 18$

$$x_2 - 2x_3 \ge 8$$

 $x_1, x_2, x_3 \ge 0$

2A. Construct the dual problem for the following primal problem: Maximize $Z = x_1 + x_2 + 2x_3$

Subject to

$$\begin{array}{l}
x_1 + x_2 + 2x_3 \\
x_1 - 3x_2 + 2x_3 = 4 \\
x_1 + x_2 + x_3 \ge 6 \\
4x_1 - 3x_2 - 5x_3 = 1 \\
x_1, x_2, x_3 \ge 0
\end{array}$$

2B. A company has factories at A, B and C which supply warehouses at D, E, F and G. Monthly factory capacities are 250, 300 and 400 units respectively for regular production. If overtime production is utilized, factory A and B produce 50 and 75 additional units respectively at overtime incremental costs of Rs. 4 and Rs. 5 respectively. The current warehouse requirements are 200, 225, 275 and 300 units respectively. Unit transportation costs in rupees from factories to warehouses are as follows:

From / To	D	Е	F	G
А	11	13	17	14
В	16	18	14	10
C	21	24	13	10

Determine the optimum distribution for this company to minimize costs using the Modified Distribution method.

2C. A company has four machines to do three jobs. Each job can be assigned to one and only one machine. The cost of each job on each machine is given in the following table:

			Macl	hines	
		W	Х	Y	Z
Jobs	А	18	24	28	32
	В	8	13	17	19
	С	10	15	19	22

What are the jobs assignments which will minimize the cost?

3A. Solve the following game by using the principle of dominance:

			Player B					
		Ι	II	III	IV	V	VI	
Player A	Ι	4	2	0	2	1	1	
	II	4	3	1	3	2	2	
	III	4	3	7	-5	1	2	
	IV	4	3	4	-1	2	2	
	V	4	3	3	-2	2	2	
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3B. Solve the following rectangular game by the LP method.

			В	
	3	-1	1	2
А	-2	3	2	3
	2	-2	-1	1

4A. Given the following data, prepare a network and determine the earliest time and latest time.4 Identify the critical path.

Activity	1-2	1-3	1-4	2-5	2-8	3-6	4-6	4-7
Duration	6	3	5	4	5	7	4	6
Activity	5-8	6-8	6-9	7-9	8-10	9-10		
Duration	3	4	3	2	6	5		

- 4B. Consider the network shown in the Fig. Q4B. The three time estimates (in the form of a, m, b) for activities are given along the arrows. Determine the critical path. What is the probability that the project will be completed in 20 days?
- **5A.** Consider the details of a distance network as shown in the table:

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

Construct the distance network. Find the shortest path from node 1 to node 9 using Dijkstra's algorithm.

5B. Consider the following details of piping network which is used to transfer oil. Draw the flow network. Determine the maximum flow from node 1 to node 6 using maximal flow technique.

	Flo	OW		Flo	OW
Arc i-j	fij	fji	Arc i-j	fij	fji
1-2	20	-	3-4	13	-
1-3	25	-	3-5	10	8
2-3	5	10	4-5	15	-
2-4	9	4	4-6	30	-
2-5	15	-	5-6	25	-

6A. A distance network consists of eleven nodes which are distributed as shown in the table. Find the shortest path from node 1 to node 11 and the corresponding distance. Use the backward recursion method to solve the network.

Arc	Distance	Arc	Distance
1-2	8	5-8	12
1-3	7	5-9	7
1-4	1	6-9	9
2-5	5	7-9	6
3-5	9	7-10	13
3-6	2	8-11	4
3-7	8	9-11	2
4-7	10	10-11	15

4

6

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6B. Maximize the function $f(x) = -3x^2 + 21.6x + 1.0$, with a minimum resolution of 0.50 over six functional evaluations. The optimal value of f(x) is assumed to lie in the range $25 \ge x \ge 0$. Use Fibonacci search technique to solve.

