Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

SEVENTH SEMESTER B.TECH. (INSTRUMENTATION & CONTROL ENGG.)

END SEMESTER EXAMINATIONS, DEC 2016/JAN 2017

SUBJECT: OPERATIONS RESEARCH [ICE 453]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.

1A. A farmer has a 100-acre farm. He can sell all the tomatoes, lettuce or radishes he can raise. The price he can obtain Rs. 1 per kg for tomatoes, Rs. 0.75 a head for lettuce and Rs. 2 per kg for radishes. The average yield per acre is 2000 kg of tomatoes, 3000 heads of lettuce and 1000 kg of radishes. Fertilizer is available at Re. 0.50 per kg and the amount required per acre is 100 kg each for tomatoes and lettuce and 50 kg for radishes. Labour required for sowing, cultivating and harvesting per acre is 5 man-days for tomatoes and radishes and 6 man-days for lettuce. A total of 400 man-days of labour are available at Rs. 20 per man-day. Formulate a linear programming model for this problem in order to maximize the farmer's total profit. **2**

1B. Solve the problem using graphical method. **3**

$$\text{Maximize } Z = 2x_1 + x_2$$

$$\text{Subject to } \quad \tfrac{3}{2} x_1 + x_2 \leq 6$$
$$x_1 \leq 2$$
$$x_1 + x_2 \geq 7$$
$$-x_1 + x_2 \geq 4$$
$$x_1, x_2 \geq 0$$

1C. Using two phase method, **5**

$$\text{Maximize } Z = 5x - 2y + 3z$$

$$\text{Subject to } \quad 2x + 2y - z \geq 2$$
$$3x - 4y \leq 3$$
$$y + 3z \leq 5$$
$$x, y, z \geq 0$$

2A. Construct the dual problem for the following: **2**

$$\text{Maximize } Z = 16x_1 + 14x_2 + 36x_3 + 6x_4$$

$$\text{Subject to } \quad 14x_1 + 4x_2 + 14x_3 + 8x_4 = 21$$
$$13x_1 + 17x_2 + 80x_3 + 2x_4 \leq 48$$
$$x_1, x_2, x_3, x_4 \geq 0$$

2B. Find the initial basic feasible solution of the following transportation problem by Vogel's approximation method. **4**

		Warehouses				
		W_1	W_2	W_3	W_4	Capacity
Factories	F_1	10	30	50	10	7
	F_2	70	30	40	60	9
	F_3	40	8	70	20	18
	Requirement	5	8	7	14	

2C. Consider the problem of assigning five operators to five machines. The assignment costs are given in the table. **4**

		Operators				
		I	II	III	IV	V
Machines	A	10	5	13	15	16
	B	3	9	18	3	6
	C	10	7	2	2	2
	D	5	11	9	7	12
	E	7	9	10	4	12

Assign the operators to different machines so that total cost is minimized.

3A. An oil company has recently acquired rights in a certain area to conduct surveys and test drilling to lead to lifting oil. The area is considered to have good potential for finding oil. At the outset, the company has a choice to conduct further geological tests or to carry out a drilling programme immediately. On the known conditions the company estimates that there is a 70:30 chance of further tests showing a 'success'. Whether the tests show the possibility of ultimate success or not, or even if no tests are undertaken at all, the company could still pursue its drilling programme or alternatively consider selling its right to drill the area. Therefore, however, if it carries out the drilling programme, the likelihood of final success or failure is considered dependent on its foregoing stages. Thus if successful tests have been carried out, the exception of success in drilling is given as 80:20. If the tests indicate 'failure', then the expectation of success in drilling is given as 20:80. If no tests have been carried out at all, the expectation of success in drilling is given as 55:45. Costs and revenues have been estimated for all possible outcomes and the net present value is given in the table: **5**

	Outcomes	Net present value (Rs. millions)
Success	With Prior tests	100
	Without prior tests	120
Failure	With Prior tests	-50
	Without prior tests	-40
Sale of exploitation rights	Prior tests show 'success'	65
	Prior tests show 'failure'	15
	Without prior tests	45

Draw a decision tree diagram to present the given information. Evaluate the tree in order to advice the management of the company on its best course of action.

3B. Solve the following rectangular game by the LP method. **5**

	B			
A	3	-1	1	2
	-2	3	2	3
	2	-2	-1	1

4A. In a game of matching coins, player A wins Rs. 2 if there are two heads, wins nothing if there are two tails and loses Re. 1 when there are one head and one tail. Determine the payoff matrix, best strategies for each player and the value of the game to A. **3**

4B. A project schedule has the following characteristics: **3**

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

Construct the network. Find the critical path and the project completion time.

4C. A project is represented by the network shown in the Fig. Q4C. The activity times (in weeks) are given in the table: **4**

Activity	A	B	C	D	E	F	G	H	I
Optimistic Time	5	18	26	16	15	6	7	7	3
Most likely time	8	20	33	18	20	9	10	8	4
Pessimistic time	10	22	40	20	25	12	12	9	5

Determine the following:

a) Expected task times and their variances.
b) The critical path.
c) The probability of completing the project in 41.5 weeks.

5A. Consider the details of a distance network as shown in the table: **5**

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. **5**

	Flow			Flow	
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. Fig. Q6A shows a network of cities spread over a state. A company has to transport some goods from city A to city J. The cost of transportation between the different cities is given along the lines connecting the nodes. A node represents a city. It is required to determine the optimal route connecting A and J. Find the optimal transportation cost by using forward and backward recursion method. **5**

6B. Minimize: $f(x) = x^4 - 15x^3 + 72\,x^2 - 1135x$. Terminate the search when $|f(X_n) - f(X_{n-1})| \leq 0.50$. The initial range of X is $1 \leq x \leq 15$. Solve using Golden Search Technique. **5**

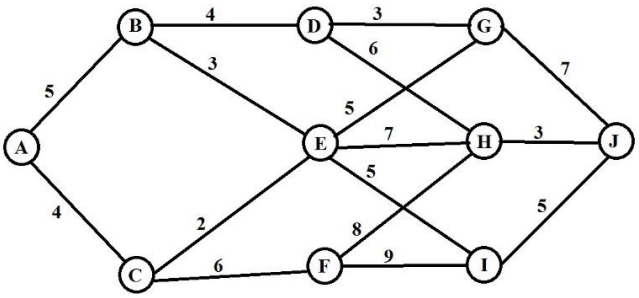

Fig. Q6A

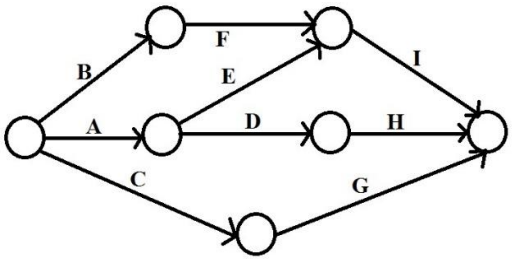

Fig. Q4C