USN | | | | | | | | | | |

10ME74

Seventh Semester B.E. Degree Examination, June/July 2019
Operations Research

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Areas under the standard normal distribution (statistical table).

PART – A

1 a. A Farmer has 100 acre farm. He can sell all tomatoes, lettuce or radishes he can raise. The price he can obtain is Rs. 1.00 per kg tomatoes, Rs. 0.75 a head for lettuce and Rs. 2.00 per kg for radishes. The average yield per acre is 2,000 kg of tomatoes, 3,000 heads of lettuce, and 1000 kgs of radishes. Fertilizer is available at Re.0.50 per kg and the amount required per acre is 100 kgs each for tomatoes and lettuce and 50 kgs 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 are available at Rs.20 per man-day. Formulate this problem as a linear programming model to maximize the farmer's total profit. **(10 Marks)**

b. Solve the following LP problem graphically :

$$\text{Max } z = 8000x_1 + 7000x_2$$

Subject to $3x_1 + x_2 \le 66$

$x_1 + x_2 \le 45$

$x_1 \le 20,\ x_2 \le 40$

and $x_1, x_2 \ge 0$. **(10 Marks)**

2 a. Use BIG-M method to maximize $Z = 3x_1 - x_2$

Subject to $2x_1 + x_2 \le 2$

$x_1 + 3x_2 \ge 3$

$x_2 \le 4$

$x_1, x_2 \ge 0$. **(10 Marks)**

b. Obtain the dual of the following primal problem:

Minimize $z = 3x_1 - 2x_2 + x_3$

Subject to $2x_1 - 3x_2 + x_3 \le 5$

$4x_1 - 2x_2 \ge 9$

$-8x_1 + 4x_2 + 3x_3 = 8$.

$x_1, x_2 \ge 0$, x_3 is unrestricted. **(10 Marks)**

3 a. Find the optimal solution to the following:
Transportation problem shown in Table Q3 (a) in which the calls contain the transportation. Cost in Rupees. **(10 Marks)**

		To Ware houses					
		W_1	W_2	W_3	W_4	W_5	Available
From	F_1	7	6	4	5	9	40
	F_2	8	5	6	7	8	30
	F_3	6	8	9	6	5	20
	F_4	5	7	7	8	6	10
Required		30	30	15	20	5	

Table Q3 (a)

3 b. Solve the following Assignment problem shown in Table Q3 (b). **(10 Marks)**

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

Table Q3 (b)

4 a. What is integer programming problem, and methods adopted to solve them? **(05 Marks)**

b. Solve the following integer programming problem, using Gomary's fractional cutting plane method.

Maximize $z = x_1 + 2x_2$

Subject to Constraints $2x_2 \leq 7$

$x_1 + x_2 \leq 7$

$2x_1 \leq 11$

$x_1, x_2 \geq 0$ and are integers. **(15 Marks)**

PART – B

5 a. A project has the following time schedule, shown in Table Q5 (a).

Activity	1–2	1–3	1–4	2–5	3–6	3–7	4–6	5–8	6– 9	7–8	8–9
Duration (in months)	2	2	1	4	8	5	3	1	5	4	3

Table Q5 (a)

(i) Construct PERT network.
(ii) Compute Total float, Free float and Independal float for each activity.
(iii) Critical path and its duration. **(10 Marks)**

b. A small project is composed of seven activities whose time estimates are listed in Table Q5 (b).
(i) Draw the project network.
(ii) Find the critical path.
(iii) Find the probability of the project being completed within 19 weeks. **(10 Marks)**

Activity	Estimated Direction in Weeks		
	Optimistic most likely		Pessimistic
	a	m	b
1 – 2	1	1	7
1 – 3	1	4	7
1 – 4	2	2	8
2 – 5	1	1	1
3 – 5	2	5	14
4 – 6	2	5	8
5 – 6	3	6	15

Table Q5 (b)

6 a. What are the elements of a queuing system (structure of queuing system)? **(05 Marks)**

b. A self service stores employs one cashier at its counter. Nine customers arrive on an average every 5 minutes, while the cashier can serve 10 customers in 5 minutes. Assuming poisson's distribution for arrival rate and exponential distribution for service time. Find :
(i) Arrival and service rate per minute.
(ii) Average number of customer in the system.
(iii) Average number of customers in the queue or Average queue length.
(iv) Average time a customer spends in the system.
(v) Average time a customer waits before being served. **(15 Marks)**