SEAT No. : ☐

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B.E. (Civil)

OPERATIONS RESEARCH

(2019 Pattern) (Semester - VII) (Elective - III) (401003F)

Time : 2½ Hours]   *[Max. Marks : 70*

Instructions to the candidates:

1) *Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*

2) *Figures to the right side indicate full marks.*

3) *Use of Calculator is allowed.*

4) *Assume Suitable data if necessary.*

Q1) a) Solve following example using simplex Method   **[8]**

Maximize $Z = 15x_1 + 25x_2$

Subject to

$5x_1 + 15x_2 \leq 80$

$16x_1 + 5x_2 \leq 80$

$x_1, x_2 \geq 0$

b) State the advantages of dual-primal equations.   **[4]**

c) The Wyndor Glass Co. produces high quality glass products, including windows and glass doors. It has three plants in which two products are manufactured: Product 1- 8" glass door with aluminum frame; Product 2- a 4 x 6 feet double hung wood framed window. Product 1 requires some of the production capacity in plants 1 and 2, whereas product 2 needs only plants 2 and 3. The production time required for product 1 is 1 hr/batch and 3 hrs/batch for plants 1 and 3 respectively. The production time required for product 2 is 2 hrs/batch each for plants 2 and 3 respectively. The total production times available for plant 1 is 4 hours per week, plant 2 is 12 hrs/week and plant 3 is 18 hrs/ week. The profits earned by product 1 are Rs 3000 per batch and for product 2 is Rs. 5,000 per batch. Formulate the production schedule to maximize the profit.   **[6]**

Q2) a) Solve the following problem using Big M method **[12]**

Maximize $Z = x_1 + 2x_2 + 3x_3$

Subject to

$x_1 - x_2 + x_3 \geq 4$

$x_1 + x_2 + 2x_3 \leq 8$

$x_1 - x_3 \geq 2$

$x_1, x_2, x_3 \geq 0$

b) What the sensitivity analysis is as applied in Linear programming problem? Explain with the help of example. **[6]**

Q3) a) Explain steps involved in solving transportation problem using least cost method. **[6]**

b) What are the applications of assignment problem in construction industry? **[4]**

c) Optimize following transportation problem using VAM. **[8]**

	D1	D2	D3	D4	supply
S1	9	6	5	8	30
S2	3	7	3	9	25
S3	5	4	6	7	15
Demand	10	25	18	17	

OR

Q4) a) A company has five machines on which five jobs are performed. Each job can be assigned to only one machine. The cost of each job on each machine is given in the following table. Optimize the assignment to get minimum cost. **[8]**

Machines

	A	B	C	D	E
1	75	78	66	90	95
2	92	65	93	67	81
3	68	80	82	83	76
4	92	84	87	79	78
5	85	91	70	69	94

jobs

b) Find initial solution of the following transportation problem using **[6]**

   i)   Least cost method

   ii)   Column minima method

	A	B	C	Supply
1	20	70	40	50
2	30	30	10	80
3	50	40	70	70
4	10	60	20	140
Demand	70	90	180	

c) What is meant by unbalanced assigrnent problem? State the steps to solve such problems. **[4]**

Q5) a) What are the applications of non linear programming in Civil Engineering?**[6]**

b) Carry out the calculation for finding the maxima of following equation using Fibonacci method with 1% accuracy in the interval (2, 5) upto two iterations only. **[8]**

Maximize $f(x) = 2x^4 - 5x^3 + 4x^2$

c) What are similarities between Golden section method and Fibonacci method? **[3]**

OR

Q6) a) Maximize $Z = 2x_1 + 3x_2 - x_1^2 - 2x_2^2$ using Lagrangian Multiplier method

Subject to **[8]**

$x_1 + 3x_2 = 6$

$5x_1 + 2x_2 = 10$

$x_1, x_2 \geq 0$

b) Write a detail note on gradient method including the following points**[5]**

   i)   Type of objective function

   ii)   Application of the method

c) Using Hessian matrix, determine whether following function is convex or concave. **[4]**

$f(x) = 4x_1x_2 + 2x_1x_3 - 4x_2x_3$

Q7) a) Consider following payoff matrix for two opponents. **[9]**

Opponent 2

	P	Q	R	S
A	3	5	2	8
Opponent 1 B	2	6	5	2
C	4	7	3	9

i) Check whether there exists saddle point.

ii) Give optimum strategy for both the firms

iii) Find the value of Game

b) Rs 12,000 are to be invested in three schemes, namely A, B, C to have the best returns. The returns are as under. **[8]**

	Returns in rupees for the investment of			
	Rs. 3,000	Rs. 6,000	Rs. 9,000	Rs. 12,000
A	60	175	310	400
B	85	140	320	485
C	50	200	350	430

Using Dynamic Programming, find the best investment programme for maximum returns.

OR

Q8) a) A wheel loader is purchased for Rs. 50 lacs with expected life as 10 years. The running cost and resale price in lacs of Rs is given in the following table. **[9]**

Year	1	2	3	4	5	6	7	8	9	10
Running cost	9.5	10.9	12.8	14	16	18.3	21	24	28	33
Resale price	42.6	38.2	35	32.8	30	28	27.5	27	26	24

Find the replacement year for the wheel loader.

b) Write the applications of following OR techniques in the field of Civil Engineering. **[8]**

i) Games theory

ii) Dynamic Programming

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