CBCS SCHEME

USN | | | | | | | | | | 15CS653

Sixth Semester B.E. Degree Examination, June/July 2019
Operation Research

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define operation research. List and explain the various phases of an operation research study. **(08 Marks)**

b. A firm manufactures three products A, B and C. The profits per unit product are Rs.3, Rs.2 and Rs.4 respectively. The firm has two machines and the required processing time in minutes for each machine on each product is given below :

	Product		
Machine	A	B	C
X	4	3	5
Y	2	2	4

Machines X and Y have 2000 and 1500 machine-minutes respectively. The firm must manufacture 100A's, 200B's and 50C's but not more than 150A's. Set up an LP model to maximize the profit. **(08 Marks)**

OR

2 a. Use the graphical method to solve the following LPP :
Maximize $Z = x + 0.5y$
Subject to constraints $3x + 2y \leq 12$
$5x \leq 10$
$x + y \leq 18$
$-x + y \geq 4$
where $x, y \geq 0$. **(12 Marks)**

b. Define :i) Feasible solution ii) unbounded solution iii) Fesible region iv) Optimal solution. **(04 Marks)**

Module-2

3 a. Find all the basic solutions of the following problem :
Maximize $Z = x_1 + 3x_2 + 3x_3$
Subject to constraints $x_1 + 2x_2 + 3x_3 = 4$
$2x_1 + 3x_2 + 5x_3 = 7$
Also find which of the basic solution are :
i) basic feasible ii) non–degenerate basic feasible iii) optimal basic feasible. **(06 Marks)**

b. Solve the following LPP by Big-M method.
Maximize $Z = -2x_1 - x_2$
Subject to constraints $3x_1 + x_2 = 3$
$4x_1 + 3x_2 \geq 6$
$x_1 + 2x_2 \leq 4$
where $x_1, x_2 \geq 0$. **(10 Marks)**

OR

4 a. Solve the following LPP by simplex method.
Maximize $= 3x_1 + 2x_2$
Subject to constrains $x_1 + x_2 \leq 4$
$x_1 - x_2 \leq 4$
and $x_1, x_2 \geq 0$. **(08 Marks)**

b. Solve the following LPP by two-phase simplex method.
Maximize $z = 3x_1 - x_2$
Subject to constraints $2x_1 + x_2 \geq 2$
$x_1 + 3x_2 \leq 2$
$x_2 \leq 4$
and $x_1, x_2 \geq 0$ **(08 Marks)**

Module-3

5 a. Write applications of dual simplex method. **(06 Marks)**

b. Solve by dual simplex method the following problem :
Maximize $z = 2x_1 + 2x_2 + 4x_3$
Subject to constraints $2x_1 + 3x_2 + 5x_3 \geq 2$
$3x_1 + x_2 + 7x_3 \leq 3$
$x_1 + 4x_2 + 6x_3 \leq 5$
$x_1, x_2, x_3 \geq 0$. **(10 Marks)**

OR

6 a. Construct the dual of the problem :
i) minimize $z = 3x_1 - 2x_2 + 4x_3$
subject to constraints $3x_1 + 5x_2 + 4x_3 \geq 7$
$6x_1 + x_2 + 3x_3 \geq 4$
$7x_1 - 2x_2 - x_3 \leq 10$
$x_1 - 2x_2 + 5x_3 \geq 3$
$4x_1 + 7x_2 - 2x_3 \geq 2$
and $x_1, x_2, x_3 \geq 0$ **(05 Marks)**

ii) maximize $z = 3x_1 + 5x_2$
subject to constraints $2x_1 + 6x_2 \leq 50$
$3x_1 + 2x_2 \leq 35$
$5x_1 - 3x_2 \leq 10$
$x_2 \leq 20$
where $x_1, x_2 \geq 0$. **(05 Marks)**

b. What are the advantages of duality property? **(06 Marks)**

Module-4

7 a. Find the initial basic feasible solution by using North–West corner rule. **(06 Marks)**

	D_1	D_2	D_3	D_4	Supply
O_1	1	5	3	3	34
O_2	3	3	1	2	15
O_3	0	2	2	3	12
O_4	2	7	2	4	19
Demand	21	25	17	17	80

b. Find the initial basic feasible solution using Vogel's approximation method. **(10 Marks)**

	W_1	W_2	W_3	W_4	Availability
F_1	19	30	50	10	7
F_2	70	30	40	60	9
F_3	40	8	70	20	18
Requirement	5	8	7	14	

OR

8 a. Solve by matrix minima method and obtain an optimal solution for the following problem:

				Available
	50	30	220	1
From	90	45	170	3
	250	200	50	4
Required	4	2	2	

(10 Marks)

b. Solve the following assignment problem :

	J_1	J_2	J_3	J_4
A	2	10	9	7
B	15	4	14	8
C	13	14	16	11
D	3	15	13	8

(06 Marks)

Module-5

9 a. Define : i) pure strategy ii) mixed strategy iii) optimal strategy. **(06 Marks)**

b. Solve the following game by dominance principle.

		Player B			
		B_1	B_2	B_3	B_4
Player A	A_1	3	2	4	0
	A_2	3	4	2	4
	A_3	4	2	4	0
	A_4	0	4	0	8

(10 Marks)

OR

10 a. Solve the following game by graphical method. **(06 Marks)**

		Player B				
		I	II	III	IV	V
Player A	I	2	−1	5	−2	6
	II	−2	4	−3	1	0

b. Write short notes on :
i) Genetic algorithm
ii) Tabu search algorithm. **(10 Marks)**

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15CS653

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Operations Research

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define operations research. Explain the six major phases of operations research. **(08 Marks)**

b. Solve the Linear programming problem graphically.

$Z_{max} = 20x_1 + 24x_2$

Subject to : $2x_1 + 3x_2 \leq 1500$

$3x_1 + 2x_2 \leq 1500$

$x_2 \leq 450$ and

$x_1, x_2 \geq 0$. **(08 Marks)**

OR

2 a. Old hens can be bought at Rs.50 –each but young ones cost Rs.100 each. The old hens lay 3 eggs/week and young hens 5 eggs/week. Each egg costs Rs.2. A hen costs Rs. 5 per week to feed. If a person has only Rs. 2000 to spend for hens, formulate the problem to decide how many of each kind of hen should he buy? Assume that he cannot house more than 40 hens. **(08 Marks)**

b. With reference to Linear Programming Problem (LLP) define the following :
i) Feasible solution ii) Unbounded solution iii) Optimal solution iv) Feasible region. **(08 Marks)**

Module-2

3 a. Use simplex method to solve the following LPP (Linear Programming Problem).

Max $z = 3x_1 + 9x_2$

Subject to $x_1 + 4x_2 \leq 8$

$x_1 + 2x_2 \leq 4$ and

$x_1, x_2 \geq 0$. **(08 Marks)**

b. Solve using penalty method (Big–M)

Max $Z = 3x_1 - x_2$

Subject to : $2x_1 + x_2 \geq 2$

$x_1 + 3x_2 \leq 3$

$x_2 \leq 4$ and

$x_1, x_2 \geq 0$. **(08 Marks)**

OR

4 a. Obtain all the basic solutions for the system of linear equations :

$2x_1 + x_2 + 4x_3 = 11$

$3x_1 + x_2 + 5x_3 = 14$. **(06 Marks)**

b. Use two phase simplex method to solve the following LPP.

Max $z = 5x_1 - 4x_2 + 3x_3$

Subject to $2x_1 + x_2 - 6x_3 = 20$

$6x_1 + 5x_2 + 10x_3 \leq 76$

$8x_1 - 3x_2 + 6x_3 \leq 50$ and

$x_1, x_2, x_3 \geq 0$. **(10 Marks)**

Module-3

5 a. Write the dual of the following primal LPP.

Max $z = 3x_1 - x_2 + x_3$

Subject to : $4x_1 - x_2 \leq 8$

$8x_1 + x_2 + 3x_3 \geq 12$

$5x_1 - 6x_3 \leq 13$

$x_1, x_2, x_3 \geq 0.$ **(08 Marks)**

b. Use dual Simplex method to solve the following LPP :

Max $z = -3x_1 - x_2$

Subject to : $x_1 + x_2 \geq 1$

$2x_1 + 3x_2 \geq 2$

$x_1, x_2 \geq 0.$ **(08 Marks)**

OR

6 a. List out the procedural steps used to solve a LPP using dual simplex method. **(08 Marks)**

b. Explain briefly the essence of duality theory with an example. **(08 Marks)**

Module-4

7 a. Determine an initial basic feasible solution to the following transportation problem using North West Corner's rule. **(05 Marks)**

O/D	D_1	D_2	D_3	D_4	Supply
01	6	4	1	5	14
02	8	9	2	7	16
03	4	3	6	2	5
Required	6	10	15	4	35

b. Four jobs are to be done on four different machines. The cost [in rupees] of producing i^{th} job on j^{th} machine is given below :

		Machine			
		M_1	M_2	M_3	M_4
Jobs	J_1	15	11	13	15
	J_2	17	12	12	13
	J_3	14	15	10	14
	J_4	16	13	11	17

Assign the jobs to different machine so as to minimize the total cost. **(06 Marks)**

c. Find an initial basic feasible solution for the following transportation problem using least cost or matrix minima method :

19	30	50	10	7
70	30	40	60	9
40	80	70	20	18
5	8	7	14	

(05 Marks)

OR

8 a. Determine the optimum basic feasible solution for the following transportation problem. Obtain initial basic feasible by vogels approximation method. **(08 Marks)**

O/D	D_1	D_2	D_3	D_4	Supply
01	2	2	2	1	3
02	10	8	5	4	7
03	7	6	6	8	5
Demand	04	3	4	4	

b. Solve the following assignment problem. If it is treated as a salesman problem and the cell entries represent cost in rupees. Find the least cost route such that salesman does not visit any city twice.

	A	B	C	D	E
A	∞	2	5	7	1
B	6	∞	3	8	2
C	8	7	∞	4	7
D	12	4	6	∞	5
E	1	3	2	8	∞

(08 Marks)

Module-5

9 a. Solve the game using principle of dominance method whose payoff matrix to the player – A is given in the table. **(08 Marks)**

		Player – B		
		I	II	III
Player – B	I	1	7	2
	II	6	2	7
	III	5	2	6

b. Give a note on basic simulated annealing algorithm and basic genetic algorithm. **(08 Marks)**

OR

10 a. Solve the following game graphically. **(08 Marks)**

		Player–B		
		B_1	B_2	B_3
Player–A	A_1	2	6	22
	A_2	16	10	4

b. Explain briefly the nature of metaheurstics. **(05 Marks)**

c. Find the value of the game :

$$P_1 \begin{matrix} \\ I \\ II \end{matrix} \begin{matrix} P_2 \\ I \quad II \end{matrix} \begin{bmatrix} -4 & 6 \\ 2 & -3 \end{bmatrix}$$

(03 Marks)

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USN | | | | | | | | | | 15CS653

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Operations Research

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Define operations research. Explain the phases of operations research. **(07 Marks)**

b. A firm manufactures two types of products A and B and sells them at a profit of Rs.2 on type A and Rs.3 on type B. Each product is processed on two machines G and H. Type A requires one minute of processing time on G and two minutes of on H. Type B requires one minute of processing time on G and one minute on H. The machine G is available for not more than 6 hours 40 minutes while H is available for 10 hours during any working day. How many items of Type A and Type B should be produced so that the total profit is maximum? Formulate this problem as LPP. **(05 Marks)**

c. Using Graphical method solve the following :

Maximize $Z = 5x_1 + 4x_2$

Subject to $6x_1 + 4x_2 \le 24$

$x_1 - 2x_2 \le 6$

$-x_1 - x_2 \le 1$

$x_2 \le 2$

and $x_1, x_2 \ge 0$. **(04 Marks)**

OR

2 a. Old hens can be bought at Rs.2 each and young ones at Rs. 5 each. The old hens lay 3 eggs per week and the young ones lay 5 eggs per week, each egg being worth 30 paise. A hen (young or old) costs Rs.1 per week to feed. You have only Rs.80 to spend for buying hens. How many of each kind should you buy to give a profit of more than Rs.6 per week assuming that you cannot house more than 20 hens? Formulate the problem as an LPP. **(06 Marks)**

b. Using graphical method solve the LPP :

Minimize $Z = 20x_1 + 10x_2$

Subject to $x_1 + 2x_2 \le 40$

$3x_1 + x_2 \ge 30$

$4x_1 + 3x_2 \le 60$

and $x_1, x_2 \ge 0$. **(06 Marks)**

c. Write the meaning of following terms with respect to a LPP :
i) Feasible solution ii) Infeasible solution iii) Optimal solution iv) Unsounded solution. **(04 Marks)**

Module-2

3 a. Explain the steps involved in setting up of a Simplex method. **(08 Marks)**

b. Solve the following LPP by using Big – M method

Maximize $Z = 4x_1 + 5x_2 - 3x_3 + 50$

Subject to $x_1 + x_2 - x_3 = 10$

$x_1 - x_2 \ge 1$

$2x_1 + 3x_2 + x_3 \le 40$

and $x_1, x_2, x_3 \ge 0$. **(08 Marks)**

OR

4 a. Using Simplex method, solve the following LPP

Maximize $Z = 4x_1 + 3x_2 + 6x_3$

Subject to $2x_1 + 3x_2 + 2x_3 \leq 440$

$4x_1 + 3x_3 \leq 470$

$2x_1 + 5x_2 \leq 430$

and $x_1, x_2, x_3 \geq 0$. **(08 Marks)**

b. Define basic solution and obtain all the basic solutions to the following system of linear equations :

Maximize $z = x_1 + 3x_2 + 3x_3$

Subject to $2x_1 + 3x_2 + 4x_3 = 10$

$3x_1 + 4x_2 + x_3 = 12$

Also classify the solutions into

i) Basic Feasible Solution

ii) Non-Degenerate Basic Feasible Solution

iii) Optimal Basic Feasible Solution. **(04 Marks)**

c. Write the procedure to solve LPP of two-phase Simplex method. **(04 Marks)**

Module-3

5 a. Use dual Simplex method to solve LPP.

Minimize $Z = 2x_1 + 2x_2 + 4x_3$

Subject to $2x_1 + 3x_2 + 5x_3 \geq 2$

$3x_1 + x_2 + 7x_3 \leq 3$

$x_1 + 4x_2 + 6x_3 \leq 5$

and $x_1, x_2, x_3 \geq 0$. **(08 Marks)**

b. Explain the following :

i) The essence of duality theory

ii) Primal dual relationship **(08 Marks)**

OR

6 a. Write the procedure to solve LPP of dual Simplex method. **(08 Marks)**

b. Write the dual of the following LPP :

i) Maximize $Z = 3x_1 - x_2 + x_3$

subject to $4x_1 - x_2 \leq 8$

$8x_1 + x_2 + 3x_3 \geq 12$

$5x_1 - 6x_3 \leq 12$

and $x_1, x_2, x_3 \geq 0$

ii) Minimize $Z = 2x_2 + 8x_3$

subject to $3x_1 + x_2 \geq 12$

$2x_1 + x_2 + 6x_3 \leq 6$

$5x_1 - x_2 + 3x_3 = 4$.

and $x_1, x_2, x_3 \geq 0$. **(08 Marks)**

Module-4

7 a. Find the initial basic feasible solution to the following transportation problem using VAM.

15	10	17	18	2
16	13	12	13	6
12	17	20	11	7
3	3	4	5	

(08 Marks)

b. Find the optimal solution to the following assignment problem. (08 Marks)

		Jobs				
		J_1	J_2	J_3	J_4	J_5
Machine	M_1	11	17	8	16	20
	M_2	9	7	12	6	15
	M_3	13	16	15	12	16
	M_4	21	24	17	28	26
	M_5	14	19	12	11	13

OR

8 a. Write the procedure of Hungarian method. (06 Marks)

b. There are 3 factories A, B and C. Supply goods to 4 dealers D_1, D_2, D_3 and D_4. The production capacities of these factories are 1000, 700, 900 respectively. The requirement from this dealers are 900, 800, 500 and 400 per month respectively. The per unit returns excluding transportation cost are Rs.8/-, 7/-, 9/- at the 3 factories. The following table gives the unit production cost from the factories to dealers. Determine the optimum solution to maximize the total returns.

	D_1	D_2	D_3	D_4	
A	2	2	2	4	1000
B	3	5	3	2	700
C	4	3	2	1	900
	900	800	500	400	

(10 Marks)

Module-5

9 a. Write short notes on : i) Simulated annealing algorithm ii) Tabu search algorithm. (08 Marks)

b. Using dominance concept, obtain the optimal strategies for both the players and determine the value of game. The payoff matrix for the players is given below.

		Player B			
Player A		2	−2	4	1
		6	1	12	3
		−3	2	0	6
		2	−3	7	7

(08 Marks)

OR

10 a. Define the following with reference to game theory : i) Mixed strategy ii) Two person – zero – sum game iii) Pure strategy iv) Saddle point. (08 Marks)

b. Solve the following game graphically :

		Player B			
Player A		8	5	−7	9
		−6	6	4	−2

(08 Marks)

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