TKN/KS/16–5972

Third Semester Bachelor of Computer Application Examination

OPERATION RESEARCH – I

Paper - IV

Time : Three Hours] [Max. Marks : 50

N. B. : (1) All questions are compulsory and carry equal marks.
(2) Draw neat and labelled diagram wherever necessary.

1. (a) Discuss different steps for formulation and solving the OR problem. 5

(b) What is feasibility region ? Is it necessarty that it should always be a convex set ? 5

OR

(c) Explain graphical model of solving a LP problem. 5

(d) Solve the following LP problem by using graphical method.

Maximize $Z = 80x_1 + 120x_2$
subject to the condition

$$x_1 + x_2 \leq 9$$
$$x_1 \geq 2$$
$$x_2 \geq 3$$
$$20x_1 + 50x_2 \leq 360$$
$$x_1 , x_2 \geq 0$$

5

2. (a) Explain various steps of the simplex method involved in the computation of optimum solution to a linear programming problem. 5

(b) Solve the following LP problem using simplex method.

Maximize $z = 4x_1 + 3x_2$
subject to the constraint

$$2x_1 + x_2 \leq 1000$$
$$x_1 + x_2 \leq 800$$
$$x_1 \leq 400$$
$$x_2 \leq 700$$
$$x_1 , x_2 \geq 0$$

5

OR

(c) Give a general linear programming problem. Explain how you test a basic feasible solution is an optimal solution or not. 5

(d) Solve the following LP problem using simplex method.

Maximize $z = 6x_1 + 4x_2$
subject to the constraint

$$2x_1 + 3x_2 \leq 30$$
$$3x_1 + 2x_2 \leq 24$$
$$x_1 + x_2 \geq 3$$
$$x_1 , x_2 \geq 0$$

5

3. (a) Explain Mathematical model for transportation problem. 5

(b) Determine the initial basic feasible soultion using LCM and NWCR.

Destinations

		D_1	D_2	D_3	D_4	Supply
Source	S_1	21	16	15	3	11
	S_2	17	18	14	23	13
	S_3	32	27	18	41	19
	Demand	6	10	12	15	

5

OR

(c) Explain Vogel's Approximation method for finding an initial basic feasible solution of a transportation problem. 5

(d) Following table gives the transportation cost in Rs. from each warehouse to each market.

		P	Q	R	S	Supply
Warehouse	A	6	3	5	4	22
	B	5	9	2	7	15
	C	5	7	8	6	8
	Demand	7	12	17	9	45

Find optimal schedule and minimum transportation cost. 5

4. (a) State and discuss the methods for solving an assignment problem. How is Hungarian method is better than other methods for solving an assignment problem ? 5

(b) Five men available to do five different jobs. From past record, the time (in hour) that each man takes to do job is known and given in the following table.

	I	II	III	IV	V
A	2	9	2	7	1
B	6	8	7	6	1
C	4	6	5	3	1
D	4	2	7	3	1
E	5	3	9	5	1

Find the assignment of men to job that will minimize the total time taken. 5

OR

(c) What is an unbalanced assignment problem ? How these problems are solved to obtain the feasible solution ? Explain. 5

(d) Solve the following assignment problem

		J_1	J_2	J_3	J_4 (Job)
Workers	W_1	10	15	24	30
	W_2	16	20	28	10
	W_3	12	18	30	16
	W_4	9	24	32	18

5

5. (a) What is model in OR ? List various classification scheme of models. $2\frac{1}{2}$

(b) Give implicatins of following assumption in LP model.

(I) Linearity of the objective function and constraints.

(II) Continuious veriable. $2\frac{1}{2}$

(c) What are the main characteristics of a transportation problem ? $2\frac{1}{2}$

(d) How would you deal with the assignment problem, where the objective function is to be maximize ? $2\frac{1}{2}$

NRT/KS/19/2228

Bachelor of Computer Application (BCA) Semester—III Examination

OPERATIONS RESEARCH—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

Note :— (1) All questions are compulsory and carry equal marks.
(2) Draw neat and labelled diagrams wherever necessary.
(3) Assume suitable data wherever necessary.

EITHER

1. (a) Define OR. Explain its scope and limitations. 5

(b) Formulate the model to maximize the profit.

Machine type	Machine time required for products (minutes)		Max time available per week (minutes)
	P1	P2	
Lathe	4	9	2000
Milling	12	5	5000
Grinding	6	10	900
Profit/Unit	Rs. 40	Rs. 60	

5

OR

(c) Explain phases of OR. 5

(d) Find the status of the following LPP graphically :—

Max $Z = 6x_1 + x_2$

subject to

$2x_1 + x_2 \geq 3$

$-x_1 + x_2 \geq 0$

$x_1 \geq 0,\ x_2 \geq 0.$ 5

EITHER

2. (a) Explain Simplex Algorithm. 5

(b) Show that there is an unbounded solution to LPP.

Maximize $Z = 4x_1 + x_2 + 3x_3 + 5x_4$

subject to the constraints

$-4x_1 + 6x_2 + 5x_3 + 4x_4 \leq 20$

$3x_1 - 2x_2 + 4x_3 + x_4 \leq 10$

$8x_1 - 3x_2 + 3x_3 + 2x_4 \leq 20$

$x_1, x_2, x_3, x_4 \geq 0.$ 5

OR

(c) Write the steps to solve LPP using two-phase method. 5

(d) Solve the given LPP using Simplex method :

Maximize $Z = 3x_1 + 2x_2$

subject to the constraints

$2x_1 + x_2 \leq 6$

$3x_1 + 4x_2 \leq 12$

$x_1,\ x_2 \geq 0.$ 5

EITHER

3. (a) Explain North-West corner method for Transportation problem. 5

(b) Solve the transportation problem using Vogel's approximation method : 5

	D1	D2	D3	D4	Supply
P1	2	3	11	7	6
P2	1	0	6	1	1
P3	5	8	15	9	10
Demand	7	5	3	2	

OR

(c) Explain Vogel's approximation method for transportation problem. 5

(d) Solve the transportation problem using least cost method : 5

	D1	D2	D3	D4	Supply
S1	11	13	17	14	250
S2	16	18	14	10	300
S3	21	24	13	10	400
Demand	200	225	275	250	

EITHER

4. (a) Explain Hungarian Method, to solve an assignment problem. 5

(b) Find the optimal solution to the given assignment problem : 5

	C1	C2	C3	C4
R1	86	11	22	42
R2	76	91	12	32
R3	50	66	82	31
R4	24	40	50	11

OR

(c) Explain Branch and Bound method for transportation problem. 5

(d) Find the optimal solution to assignment problem using Hungarian method : 5

	M1	M2	M3	M4
J1	5	7	11	6
J2	8	5	9	6
J3	4	7	10	7
J4	10	4	8	3

5. (a) Give the classification of problems in OR. 2½

(b) Define slack variable, surplus variable and artificial variable. 2½

(c) What do you mean by unbalanced transportation problem ? How will you balance it ? 2½

(d) Give the mathematical formulation of an assignment problem. 2½

NJR/KS/18/3228

Bachelor of Computer Application (B.C.A.) Semester-III (C.B.S.) Examination

OPERATIONS RESEARCH–I

Paper–IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **All** questions are compulsory and carry equal marks.

(2) Draw neat and labelled diagrams wherever necessary.

EITHER

1. (A) Explain significant features of operation research. 5

(B) Two different types of foods 'A' and 'B' are being considered to form a weekly diet. The minimum weekly requirements for fats carbohydrates and protein are 18, 24 and 16 units respectively. One kg. of food 'A' has 4, 16 and 8 units respectively of these ingredients and one kg. of Food 'B' has 12, 4 and 6 units respectively. The price of food 'A' is Rs. 6 per kg and that of food 'B' is Rs. 5 per kg. How many kg. of each type of food should be buy per week to minimize the cost and meet these requirements. Formulate this as L.P.P. 5

OR

(C) Explain the phases of operation research. 5

(D) Solve the following L.P.P. by graphical method :

Maximize $Z = 4x_1 + 3x_2$

subject to the constraints

$2x_1 + x_2 \leq 1000$; $x_1 + x_2 \leq 800$;

$x_1 \leq 400$; $x_2 \leq 700$ and $x_1, x_2 \geq 0$. 5

EITHER

2. (A) Solve the following L.P.P. using Simplex method :

Maximize $Z = 3x_1 + 2x_2$

subject to the constraints :

$$x_1 + x_2 \leq 3$$
$$x_1 \leq 2$$
$$-2x_1 + x_2 \leq 1$$

and $x_1, x_2 \geq 0$. 5

(B) Give the steps for formulating a dual problem of a primal problem. 5

OR

(C) Use penalty method (Big-M) to :

Maximize $Z = 2x_1 + 3x_2$

subject to the constraints :

$$x_1 + 2x_2 \leq 4$$
$$x_1 + x_2 = 3$$

and $x_1, x_2, \geq 0$. 5

(D) Obtain the dual of L.P.P. :

Minimize $Z = 4x_1 + 6x_2 + 18x_3$

subject to the constraints :

$x_1 + 3x_2 \geq 3$

$x_2 + 2x_3 \geq 5$

and $x_j \geq 0 \quad (j = 1, 2, 3)$. 5

EITHER

3. (A) Explain mathematical model for transportation problem. 5

(B) Solve the following transportation problem using Vogel's approximation method :

		Destination			
Source		1	2	3	**Availability**
1		20	22	40	100
2		24	35	17	150
3		32	30	10	125
Requirements		75	125	175	

5

OR

(C) Write down an algorithm for least-cost method. 5

(D) What is unbalanced transportation problem ?

Solve the following transportation problem :

	1	2	3	4	**Supply**
A	4	6	8	13	50
B	13	11	10	8	70
C	14	4	10	13	30
D	9	11	13	8	50
Demand	25	35	105	20	

5

EITHER

4. (A) Define assignment problem and give the mathematical formulation of the assignment problem. 5

(B) Solve the following assignment problem :

		Workers			
		W	**X**	**Y**	**Z**
	A	8	7	9	10
Jobs	**B**	7	9	9	8
	C	10	8	7	11
	D	10	6	8	7

5

OR

(C) Explain Branch and Bound technique to solve assignment problem. 5

(D) Solve the following assignment problem to minimize the cost of assignment :

Cost Matrix : $\begin{bmatrix} 8 & 7 & 6 \\ 5 & 7 & 8 \\ 6 & 8 & 7 \end{bmatrix}$ 5

5. Attempt **all** :

(A) Give the classification of models in operations research. 2½

(B) Write the following L.P.P. in standard form :

Maximize $Z = 4x_1 + 5x_2$

subject to the constraints ;

$6x_1 + 5x_2 \leq 250$; $6x_1 + 5x_2 \geq 150$;

$4x_1 + 6x_2 \leq 200$; $9x_1 + 5x_2 \geq 130$;

and $x_1, x_2 \geq 0$. 2½

(C) Explain North-West corner rule to find initial basic feasible solution of T.P. 2½

(D) Draw the associated network for the following assignment table :

	J_1	J_2	J_3
W_1	12	22	30
W_2	20	9	15
W_3	17	25	10

2½

NKT/KS/17/5261

Bachelor of Computer Application (B.C.A.) Semester-III (C.B.S.) Examination

OPERATIONS RESEARCH—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

Note :— (1) All questions are compulsory and carry equal marks.

(2) Draw neat and labelled diagram wherever necessary.

EITHER

1. (a) Explain the phases of Operations Research. 5

(b) Solve the following lp problem graphically :

Max. $Z = 3x + 2y$

subject to the constraints :

$-2x + 3y \leq 9$

$2x - 2y \leq -20$; $x, y \geq 0$. 5

OR

(c) A firm produces three products. These products are produced on three different machines. The time required to manufacture one unit of each of the three products and the daily capacity of the three machines are given in the table below :

Machines	Time per unit (minutes)			Machine capacity (Minutes/day)
	Product 1	Product 2	Product 3	
M_1	2	3	2	440
M_2	4	–	3	470
M_3	2	5	–	430

It is required to determine the daily number of units to be manufactured for each product. The profit per unit for product 1, 2 and 3 is Rs. 4, Rs. 3 and Rs. 6 respectively. It is assumed that all the amounts produced are consumed in the market. Formulate the mathematical model that will maximize the daily profit. 5

(d) Explain origin and the development of Operation Research. 5

EITHER

2. (a) Solve the following lpp by Simplex method :

Max. $Z = 3x_1 + 4x_2$

subject to the constraints :

$x_1 + x_2 \leq 450$

$2x_1 + x_2 \leq 600$

where $x_1, x_2 \geq 0$. 5

(b) What is meant by dual ? What are the applications of duality ? Explain in details. 5

OR

(c) Solve the following lpp by Big-M method :

Max. $Z = 3x_1 - x_2$

subject to constraints :

$2x_1 + x_2 \leq 2$

$x_1 + 3x_2 \geq 3$

$x_2 \leq 4$

where $x_1, x_2 \geq 0$. 5

(d) Use two phase method for the following lpp :

Max. $Z = 5x_1 + 3x_2$

subject to constraints :

$2x_1 + x_2 \leq 1$

$x_1 + 4x_2 \geq 6$

where $x_1, x_2 \geq 0$. 5

EITHER

3. (a) Solve the following transportation problem by Vogel's Approximation method :

Distribution Centres

		D_1	D_2	D_3	D_4	Supply
	F_1	3	4	5	6	10
Factory	F_2	7	9	8	5	12
	F_3	9	7	6	4	15
	F_4	8	6	7	7	18
Demand		11	11	16	17	

5

(b) Solve the following transportation problem by least cost method :

Warehouses

		W_1	W_2	W_3	W_4	Supply
Stores	S_1	2	3	11	7	6
	S_2	1	0	6	1	1
	S_3	5	8	15	9	10
	Demand	7	5	3	2	

5

OR

(c) Explain the mathematical model for transportation problem. 5

(d) Solve the following transportation problem by North West Corner Rule.

Stores

		1	2	3	4	Production capacity
Factories	A	4	6	8	13	50
	B	13	11	10	8	70
	C	14	4	10	13	30
	D	9	11	13	3	50
	Demand	25	35	105	20	

5

EITHER

4. (a) Discuss the step of Hungarian method to solve the assignment problem. 5

(b) Solve assignment problem using branch and bound method :

Operators

		a	b	c	d
Jobs	1	13	5	8	10
	2	9	15	18	10
	3	12	14	10	10
	4	10	14	9	12

5

OR

(c) Solve the following assignment problem to maximize the sales :

		Territories				
		I	**II**	**III**	**IV**	**V**
Salesmen	**A**	10	15	17	14	14
	B	6	18	10	12	16
	C	8	5	13	13	6
	D	12	11	16	10	12

5

(d) Explain Branch and Bound technique to solve assignment problem. 5

5. (a) Draw the feasible region for the constraints :

$2x_1 + 5x_2 \leq 10$

$3x_1 + 4x_2 \leq 12$ 2½

(b) Construct the dual of the primal problem :

Max. $Z = 3x_1 + 5x_2$

subject to the constraints :

$2x_1 + 6x_2 \leq 50$

$3x_1 + 2x_2 \leq 35$

$5x_1 - 3x_2 \leq 10$

$x_2 \leq 20$; where $x_1, x_2 \geq 0$. 2½

(c) Find the initial basic feasible solution to the transportation problem by matrix minima method :

		To			**Supply**
From		2	7	4	5
		3	3	1	8
		5	4	7	7
		1	6	2	14
Demand		7	9	18	

2½

(d) What is meant by first feasible solution in Assignment problem ? Explain with example. 2½

Bachelor of Computer Application (B.C.A.) Semester-III (C.B.S.) Examination

OPERATIONS RESEARCH–I

Paper–IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **All** questions are compulsory and carry equal marks.

(2) Draw neat and labelled diagrams wherever necessary.

EITHER

1. (A) Explain significant features of operation research. 5

(B) Two different types of foods 'A' and 'B' are being considered to form a weekly diet. The minimum weekly requirements for fats carbohydrates and protein are 18, 24 and 16 units respectively. One kg. of food 'A' has 4, 16 and 8 units respectively of these ingredients and one kg. of Food 'B' has 12, 4 and 6 units respectively. The price of food 'A' is Rs. 6 per kg and that of food 'B' is Rs. 5 per kg. How many kg. of each type of food should be buy per week to minimize the cost and meet these requirements. Formulate this as L.P.P. 5

OR

(C) Explain the phases of operation research. 5

(D) Solve the following L.P.P. by graphical method :

Maximize $Z = 4x_1 + 3x_2$

subject to the constraints

$2x_1 + x_2 \leq 1000$; $x_1 + x_2 \leq 800$;

$x_1 \leq 400$; $x_2 \leq 700$ and $x_1, x_2 \geq 0$. 5

EITHER

2. (A) Solve the following L.P.P. using Simplex method :

Maximize $Z = 3x_1 + 2x_2$

subject to the constraints :

$$x_1 + x_2 \leq 3$$
$$x_1 \leq 2$$
$$-2x_1 + x_2 \leq 1$$

and $x_1, x_2 \geq 0$. 5

(B) Give the steps for formulating a dual problem of a primal problem. 5

OR

(C) Use penalty method (Big-M) to :

Maximize $Z = 2x_1 + 3x_2$

subject to the constraints :

$$x_1 + 2x_2 \leq 4$$
$$x_1 + x_2 = 3$$

and $x_1, x_2, \geq 0$. 5

(D) Obtain the dual of L.P.P. :

Minimize $Z = 4x_1 + 6x_2 + 18x_3$

subject to the constraints :

$x_1 + 3x_2 \geq 3$

$x_2 + 2x_3 \geq 5$

and $x_j \geq 0 \quad (j = 1, 2, 3)$. 5

EITHER

3. (A) Explain mathematical model for transportation problem. 5

(B) Solve the following transportation problem using Vogel's approximation method :

		Destination			
Source		1	2	3	**Availability**
1		20	22	40	100
2		24	35	17	150
3		32	30	10	125
Requirements		75	125	175	

5

OR

(C) Write down an algorithm for least-cost method. 5

(D) What is unbalanced transportation problem ?

Solve the following transportation problem :

	1	2	3	4	**Supply**
A	4	6	8	13	50
B	13	11	10	8	70
C	14	4	10	13	30
D	9	11	13	8	50
Demand	25	35	105	20	

5

EITHER

4. (A) Define assignment problem and give the mathematical formulation of the assignment problem. 5

(B) Solve the following assignment problem :

		Workers			
		W	**X**	**Y**	**Z**
	A	8	7	9	10
Jobs	**B**	7	9	9	8
	C	10	8	7	11
	D	10	6	8	7

5

OR

(C) Explain Branch and Bound technique to solve assignment problem. 5

(D) Solve the following assignment problem to minimize the cost of assignment :

Cost Matrix : $\begin{bmatrix} 8 & 7 & 6 \\ 5 & 7 & 8 \\ 6 & 8 & 7 \end{bmatrix}$ 5

5. Attempt **all** :

(A) Give the classification of models in operations research. 2½

(B) Write the following L.P.P. in standard form :

Maximize $Z = 4x_1 + 5x_2$

subject to the constraints ;

$6x_1 + 5x_2 \leq 250$; $6x_1 + 5x_2 \geq 150$;

$4x_1 + 6x_2 \leq 200$; $9x_1 + 5x_2 \geq 130$;

and $x_1, x_2 \geq 0$. 2½

(C) Explain North-West corner rule to find initial basic feasible solution of T.P. 2½

(D) Draw the associated network for the following assignment table :

	$\mathbf{J_1}$	$\mathbf{J_2}$	$\mathbf{J_3}$
$\mathbf{W_1}$	12	22	30
$\mathbf{W_2}$	20	9	15
$\mathbf{W_3}$	17	25	10

2½

KNT/KW/16/5261

Bachelor of Computer Application (B.C.A.) Semester–III (C.B.S) Examination

OPERATIONS RESEARCH–I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **ALL** questions are compulsory and carry equal marks.

(2) Draw neat and labelled diagram wherever necessary.

EITHER

1. (a) State different types of models used in OR. Explain briefly the general model for solving OR problem. 5

(b) Use the graphical method to solve following LP problem : 5

Minimize $Z = x_1 + x_2$

subject to the constraints :

$-x_1 + 3x_2 \leq 10$

$x_1 + x_2 \leq 6$

$x_1 - x_2 \leq 2$

$x_1, x_2 \geq 0$

OR

(c) Explain different phases of operations research. 5

(d) Solve the following LP problem using graphical method :

Maximize $Z = 20x_1 + 10x_2$

subject to the constraints :

$x_1 + 2x_2 \leq 40$

$3x_1 + x_2 \geq 30$

$4x_1 + 3x_2 \geq 60$

$x_1, x_2 \geq 0$ 5

EITHER

2. (a) What do you mean by optimal basic feasible solution to a linear program problem ? Explain with example. 5

(b) Use penalty (Big-M) method to solve the following LP problem :

Maximize $Z = 2x_1 + x_2$

subject to the constraints :

$3x_1 + x_2 = 3$

$4x_1 + 3x_2 \geq 6$

$x_1 + 2x_2 \leq 4$

$x_1, x_2 \geq 0$ 5

OR

(c) How do the graphical and simplex methods of solving LP problem differ ? In what way are they same ? What are limitations of graphical method ? 5

(d) Solve the following LP problem using simplex method :

Maximize $Z = 6x_1 + 4x_2$

subject to the constraint :

$2x_1 + 3x_2 \leq 30$

$3x_1 + 2x_2 \leq 24$

$x_1 + x_2 \geq 3$

$x_1, x_2 \geq 0$ 5

EITHER

3. (a) What is degeneracy in transportation problem ? How is a transportation problem solved when demand and supply are not equal ? 5

(b) A manufacturer wants to ship 22 loads of his product as shown below. The matrix gives the kilometer from source to the destination :

Destinations

		D_1	D_2	D_3	D_4	D_5	supply
Sources	S_1	5	8	6	6	3	8
	S_2	4	7	7	6	5	5
	S_3	8	4	6	6	4	9
	Demand	4	4	5	4	8	25 / 22

Shipping cost is Rs. 10 per load per km. What shipping schedule should be used to maximize total cost of transportation ? 5

OR

(c) Describe general mathematical model of transportation model. List different methods to be used to solve the transportation problem. 5

(d) Determine the optimal distribution for the company to minimize total shipping cost :

Warehouse

		W_1	W_2	W_3	supply
Factory	F_1	16	20	12	200
	F_2	14	08	18	160
	F_3	26	24	16	90
	Demand	180	120	150	450

Unit shipping cost is given in the above table. 5

EITHER

4. (a) Construction company has requested bids for subcontracts on five different projects. Five companies have responded, their bits are represented below : 5

Bid Amount (in thousands)

	I	II	III	IV	V
1	41	72	39	52	25
2	22	29	49	65	81
3	27	39	60	51	40
4	45	50	48	52	37
5	29	40	45	26	30

Determine the minimum cost assignment of subcontract to bidder, assuming that each bidder can receive only one contract.

(b) Discuss the mathematical model of assignment problem. List methods for solving assignment problem. 5

OR

(c) A departmental head has four subordinates and four tasks to be performed. The subordinate differ in efficiency and the task differ in their intrinsic difficulty. His estimate of time that each man would take to perform each task is given below :

Task

		I	II	III	IV
Subordinate	A	8	28	17	11
	B	13	28	4	26
	C	38	19	18	15
	D	19	28	24	10

How should the task be allowed to subordinate so as to minimize man-hour ? 5

(d) Give an algorithm to solve assignment problem. 5

5. Attempt **all** :

(a) Model Building is the essence of the operation research approach. Discuss in brief. 2½

(b) What is linear programming ? What are its major assumptions and limitations ? 2½

(c) Describe the computational procedure of optimality test in transportation problem. 2½

(d) Discuss the travelling salesman's problem in an assignment problem. 2½

Bachelor of Computer Application (B.C.A.) Semester—III Examination

OPERATIONS RESEARCH—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **All** questions are compulsory and carry equal marks.

(2) Draw neat and labelled diagram wherever necessary.

EITHER

1. (a) Discuss various classification of problems in Operation Research. 5

(b) Solve the following Linear Programming Problem using graphical method :

Minimize $Z = -x_1 + 2x_2$

subject to constraints : $-x_1 + 3x_2 \leq 10$

$x_1 + x_2 \leq 6$

$x_1 - x_2 \leq 2$

and $x_1 \geq 0, x_2 \geq 0.$ 5

OR

(c) Explain the characteristics of OR. 5

(d) Explain the graphical method of solving a Linear Programming Problem. 5

EITHER

2. (a) Discuss the various steps involved in the formulation of primal-dual pair. 5

(b) Solve the following problem using two-phase Simplex Method :

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

subject to constraints : $2x_1 + x_2 - 6x_3 = 20$

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

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

$x_1, x_2, x_3 \geq 0.$ 5

OR

(c) Explain in detail Two-phase method to solve the Linear Programming Problems having artificial variables. 5

(d) Obtain the dual problem of the following primal problem :

Minimize $Z = x_1 - 3x_2 - 2x_3$

subject to constraints : $3x_1 - x_2 + 2x_3 \leq 7$

$2x_1 - 4x_2 \geq 12$

$-4x_1 + 3x_2 + 8x_3 = 10$

$x_1, x_2 \geq 0$ and x_3 is unrestricted. 5

EITHER

3. (a) Explain North-West Corner method to solve transportation problem for an initial solution. 5

(b) Obtain an initial basic feasible solution to the following transportation problem using least-cost method :

	D_1	D_2	D_3	D_4	Capacity
O_1	1	2	3	4	6
O_2	4	3	2	0	8
O_3	0	2	2	1	10
Demand	4	6	8	6	24

where O_i and D_j denote i^{th} origin and j^{th} destination respectively. 5

OR

(c) Discuss Vogel's approximation method to find initial basic feasible solution of transportation problem. 5

(d) Find the optimal solution of the following transportation problem using least cost method :

		Godown				
		G_1	G_2	G_3	G_4	Supply
Plants	P_1	2	3	11	7	6
	P_2	1	0	6	1	1
	P_3	5	8	15	9	10
		7	5	3	2	

5

EITHER

4. (a) What is an assignment problem ? Give the mathematical formulation of an assignment problem. 5

(b) Solve the following assignment problem :

	C_1	C_2	C_3	C_4
R_1	86	11	22	42
R_2	76	91	12	32
R_3	50	66	82	31
R_4	24	40	56	11

5

OR

(c) A department head has four tasks to be performed and three subordinates, the subordinates differ in efficiency. The estimates of the time, each subordinate would take to perform, is given below in the matrix. How should be allocate the tasks one to each man, so as to minimize the total man-hours ?

Task	Men		
	1	2	3
I	9	26	15
II	13	27	6
III	35	20	15
IV	18	30	20

5

(d) Explain different methods used to solve the assignment problem. 5

5. Attempt **ALL** :

(a) Write down the four basic assumptions which are necessary for all Linear Programming Problems. 2½

(b) Define the following terms :

(i) Basic variable

(ii) basic solution

(iii) Degenerate solution

(iv) Basic feasible solution

(v) Improved basic solution. 2½

(c) Write a short note on 'Duality in Transportation problem' with example. 2½

(d) Explain in short the maximization case in Assignment problem. 2½

Bachelor of Computer Application (B.C.A.) Semester—III Examination

OPERATIONS RESEARCH—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **All** questions are compulsory and carry equal marks.

(2) Assume suitable data wherever necessary.

(3) Draw neat and labelled diagrams wherever necessary.

EITHER

1. (A) Explain the uses and limitations of OR. 5

(B) Solve the following LPP using graphical method :

Maximize $Z = 5x_1 + 10x_2$

subject to $x_1 + 2x_2 \leq 10$

$3x_1 + x_2 \leq 12$

with $x_1, x_2 \geq 0$. 5

OR

(C) Explain the phases of OR in detail. 5

(D) Solve the following LPP using graphical method :

Minimize $Z = 4x_1 + 3x_2$

subject to $5x_1 + x_2 \geq 10$

$2x_1 + x_2 \geq 12$

$x_1 + 4x_2 \geq 12$

with $x_1, x_2 \geq 0$. 5

EITHER

2. (A) Solve the following LPP using simplex method :

Maximize $Z = 3x_1 + 2x_2$

subject to $x_1 + x_2 \leq 15$

$2x_1 + x_2 \leq 28$

$x_1 + 2x_2 \leq 20$

with $x_1, x_2 \geq 0$. 5

(B) State and prove duality theorem. 5

OR

(C) Obtain the dual of the following LPP :

Maximize $Z = 2x_1 + 5x_2 + 6x_3$

subject to $5x_1 + 6x_2 - x_3 \leq 3$

$-2x_1 + x_2 + 4x_3 \leq 4$

$x_1 - 5x_2 + 3x_3 \leq 1$

$-3x_1 - 3x_2 + 7x_3 \leq 6$

with $x_1, x_2, x_3 \geq 0$. 5

(D) What is artificial variable ? Write the steps of Big-M method to solve LPP. 5

EITHER

3. (A) Determine an initial basic feasible solution to the following Transportation Problem using North-West-Corner-Rule :

Origin	**Destination**				**Supply**
	D_1	**D_2**	**D_3**	**D_4**	
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
Demand	6	10	15	4	

5

(B) Write and explain the steps to solve the Transportation Problem using Vogel's Approximation Method. 5

OR

(C) Write an algorithm to solve the Transportation Problem using Matrix Minima Method. 5

(D) Determine an initial basic feasible solution for the following Transportation Problem using Row Minima Method :

	Destination				
Source	**D_1**	**D_2**	**D_3**	**D_4**	**Supply**
S_1	10	2	20	11	15
S_2	12	7	9	20	25
S_3	4	14	16	18	10
Demand	5	15	15	15	

5

EITHER

4. (A) A department has four subordinates and four tasks are to be performed. The subordinates differ in efficiency and the tasks differ in their intrinsic difficulties. The estimate of time (in man-hours), each man would take to perform each task is given by :

Subordinate	**Task**			
	A	**B**	**C**	**D**
1	8	26	17	11
2	13	28	4	26
3	38	19	18	15
4	19	26	24	10

How should the tasks be allocated to men so as to optimize the total man hours ? 5

(B) Explain Branch and Bound method of solving an assignment problem. 5

OR

(C) What is Assignment Problem ? Give its mathematical formulation. 5

(D) Solve the following assignment problem using Branch and Bound method. The cell entries represent the processing time in hours (C_{ij}) of the Job i if it is assigned to Operator j :

Job i	**Operator j**			
	I	**II**	**III**	**IV**
1	23	20	21	24
2	19	21	20	20
3	20	18	24	22
4	22	18	21	23

5

5. (A) What are the characteristics of OR ? 2½

(B) Define the terms :

(i) Slack variable

(ii) Surplus variable

(iii) Basic variable and non-basic variable. 2½

(C) Discuss the Matrix form of Transportation Problem. 2½

(D) What do you mean by balanced and unbalanced assignment problem ? Explain. 2½