Roll No. .....

Exam Code : M-23

Subject Code—12036

B. Sc. (Hons.) EXAMINATION

(Batch 2016 Onwards)

(Fourth Semester)

MATHEMATICS

BML-405

Operations Research–I

Time : 3 Hours *Maximum Marks : 70*

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

(Compulsory Question)

1. (a) What is Operations Research ? Explain in brief. **2**

(b) Write all the coditions for standard form of Linear Programming Problem (LPP) with example. 2

(c) Does the following LPP has a feasible solution ?

Max. : $Z = x_1 + x_2$

Subject to :

$$2x_1 - 3x_2 \geq 4,$$

$$x_2 - 2x_1 \geq 0,$$

$$x_1, x_2 \geq 0.$$ 2

(d) Obtain the dual of the following LPP :

Min. : $Z = x_1 + x_2 + x_3$

Subject to the constraints :

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

$$x_1 - 2x_2 \leq 3,$$

$$2x_2 - x_3 \geq 4,$$

$$x_1, x_2 \geq 0$$

and x_3 is unrestricted. 2

(e) With reference to a transportation problem define the following terms : 2

(i) Feasible solution

(ii) Basic feasible solution

(iii) Optimal solution.

(f) Write a short note on Assignment problem. 2

(g) Explain zero-sum two-person game giving suitable example. 2

Unit I

2. (a) Write the scope and any *ten* applications of operations research. 7

(b) Explain the meaning of a Linear Programming Problem, stating its advantages and write its limitations. 7

3. (a) A leather company manufactures two types of belts B_1 and B_2. Each of these sell at a profit of Rs. 2 per belt. Each belt is processed on two machines M_1 and M_2. The B_1 type belt requires one minute of processing time on machine

M_1 and two minutes on machine M_2. The B_2 type belt requires one minute of processing time on each of the machines M_1 and M_2. While machine M_1 is available for a maximum of 6 hours and 40 minutes, machine M_2 is available for 10 hours on all working days. Formulate the given problem as an LPP and solve it using the graphical method. 7

(b) Solve the Linear Programming Problem (LPP) by graphical method :

Min. : $Z = 3x_1 + 5x_2$

Subject to :

$$-3x_1 + 4x_2 \leq 12,$$

$$2x_1 - x_2 \geq -2,$$

$$2x_1 + 3x_2 \geq 12,$$

$$x_1 \leq 4,$$

$$x_2 \geq 2,$$

$$x_1, x_2 \geq 0.$$ 7

Unit II

4. (a) Describe a computational procedure of the simplex method for the solution of a maximization LPP. 7

(b) Solve the following LPP using the Simplex method :

Max. : $Z = 4x_1 + 6x_2$

Subject to :

$$2x_1 + 3x_2 \leq 6,$$
$$x_1 - x_2 \leq 1,$$
$$x_1, x_2 \geq 0.$$

Further, determine the alternate optimal solution if it exists. 7

5. (a) Solve the following LPP using the Big-M method :

Max. : $Z = 4x_1 + 5x_2 - 3x_3$

Subject to :

$$x_1 + x_2 + x_3 = 10,$$
$$x_1 - x_2 \geq 1,$$
$$2x_1 + 3x_2 + x_3 \leq 40,$$
$$x_1, x_2, x_3 \geq 0.$$ 7

(b) Using two-phase method solve the following LPP :

Max. : $Z = 5x_1 - 2x_2 + 3x_3$

Subject to :

$$2x_1 + 2x_2 - x_3 \geq 2,$$
$$3x_1 - 4x_2 \leq 3,$$
$$x_2 + 3x_3 \leq 5,$$
$$x_1, x_2, x_3 \geq 0.$$

7

Unit III

6. (a) Describe primal-dual pair relationship. Prove that dual of the dual of a given primal is the primal. 7

(b) Apply the principle of duality to solve the Linear Programming Problem (LPP) :

Max. : $Z = 3x_1 - 2x_2$

Subject to :

$$x_1 + x_2 \leq 5,$$
$$x_1 \leq 4,$$
$$1 \leq x_2 \leq 6,$$
$$x_1, x_2 \geq 0.$$

7

7. (a) Determine the optimal basic feasible solution to the following transporatation problem using the MODI method : 7

		To				
		D_1	D_2	D_3	D_4	Available
	O_1	5	3	6	2	19
From	O_2	4	7	9	1	37
	O_3	3	4	7	5	34
Required		16	18	31	25	

(b) Find an optimum basic feasible solution to the following transportation problem (Use dummy destinations, if needed) : 7

		Dertination					
		D_1	D_2	D_3	D_4	D_5	Available
	O_1	5	4	8	6	5	600
Orgin	O_2	4	5	4	3	2	400
	O_3	3	6	5	8	4	1000
Required		450	400	200	250	300	

Unit IV

8. (a) Find men are available to do five different jobs. From past records, the time (in hours) that each man takes to do each job is known and given in the following table :

Man \ Jobs	J_1	J_2	J_3	J_4	J_5
M_1	2	9	2	7	1
M_2	6	8	7	6	1
M_3	4	6	5	3	1
M_4	4	2	7	3	1
M_5	5	3	9	5	1

Find the assignment of men to jobs that will minimize the total time taken. 7

(b) A company has 5 jobs to be done. The following matrix shows the return in rupees on assigning ith (i = 1, 2, 3, 4, 5) machine to the jth job (j = A, B, C,

D, E). Assign the five jobs to the five machines so as to maximize the total expected profit. 7

Machine \ Job	A	B	C	D	E
1	5	11	10	12	4
2	2	4	6	3	5
3	3	12	5	14	6
4	6	14	4	11	7
5	7	9	8	12	5

9. (a) Solve the following game using the graphical method : 7

Player B

Player A	B_1	B_2
A_1	1	2
A_2	5	6
A_3	−7	−9
A_4	−4	−3
A_5	2	1

(b) Solve the following game using the linear programming method : 7

		Player B		
		B_1	B_2	B_3
Player A	A_1	3	–4	2
	A_2	1	–3	–7
	A_3	–2	4	7