

(i) Printed Pages: 7

Roll No. ....

(ii) Questions : 14

Sub. Code :

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Exam. Code :

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Bachelor of Commerce 6<sup>th</sup> Semester

(2040)

OPERATIONAL RESEARCH

Paper—BCM-605

Time Allowed : ~~Three Hours~~

[Maximum Marks : 80]

**Note:** Attempt 50% of Total Questions of Question Paper. Time: 2 Hours  
All will carry equal marks. Fraction will be lower digit.

~~programmable calculator is allowed. Each question in  
Section-A carries 5 marks. Each question in Section-B and  
Section-C carries 15 marks.~~

SECTION—A (4×5)

1. Find the dual of the following problem :

Maximize  $Z = 6x_1 + 8x_2$

Subject to  $2x_1 + 3x_2 \leq 16$

$$4x_1 + 2x_2 \geq 16$$

$$2x_1 + x_2 = 16$$

$$x_1, x_2 \geq 0$$

2. Consider a transportation problem with  $m = 3$  and  $n = 4$  where :

$$C_{11} = 2, C_{12} = 3, C_{13} = 11, C_{14} = 7$$

$$C_{21} = 1, C_{22} = 0, C_{23} = 6, C_{24} = 1$$

$$C_{31} = 5, C_{32} = 8, C_{33} = 15, C_{34} = 9$$

$$\text{Suppose } S_1 = 6, S_2 = 1, S_3 = 10 \text{ and } D = 7, D_2 = 5, D_3 = 3 \text{ and } D_4 = 2.$$

Apply transportation method to find an optimal solution.

3. A company has four sales representatives who are to be assigned to four different sales territories. The monthly sales increase estimated for each sales representative for different sales territories (in lakhs of rupees) are shown in following table :

Salesmen	Sales Territories			
	I	II	III	IV
A	200	750	170	220
B	160	120	150	140
C	190	195	190	200
D	180	175	160	190

Suggest optimal assignment and total maximum sales increase per month.

4. Solve the following game graphically. Pay off matrix for player A is given :

	$a_1$	$a_2$	$a_3$	$a_4$
$b_1$	-7	7	-4	8
$b_2$	6	-4	-2	-6



5. A manufacturer is offered two machines A and B. A is priced at Rs. 5,000, with running cost at Rs. 800 for each of the first five years, increasing by Rs. 200 per year in the sixth and subsequent years. Machine B, which has the same capacity as machine A, costs Rs. 2,500 but will have remaining cost of Rs. 1,200 per year for six years, increasing by Rs. 200 per year thereafter.

If money is worth 10% per year, which machine should be purchased. Assume running cost is incurred in the beginning the year.

6. Apply (i) Maximin (ii) Maximax (iii) Minimax regret to the following pay-off matrix :

States of nature Act	$S_1$	$S_2$
$A_1$	-6	2
$A_2$	4	1
$A_3$	7	-4

### SECTION—B (2×15)

7. Use Simplex to solve :

$$\text{Max } Z = 15x_1 + 25x_2$$

$$\text{Subject to } 7x_1 + 6x_2 \geq 20$$

$$8x_1 + 5x_2 \leq 30$$

$$3x_1 - 2x_2 = 1.8$$

$$\text{where } x_1, x_2 \geq 0$$

8. An animal feed company must produce 200 kg of a mixture consisting of ingredients  $X_1$  and  $X_2$ .  $X_1$  costs Rs. 3 per kg and  $X_2$  costs Rs. 8 per kg. No more than 80 kg of  $X_1$  can be used and at least 60 kg of  $X_2$  must be used. Formulate L.P.P. and solve it graphically.
9. A solicitor firm employs typists on hourly piece rate basis for their daily work. There are five typists for service and their charges and speeds are different. According to an earlier understanding only one job is given to one typist and if time taken are in fractions then fractions are ignored. Find the least cost allocation for the data on below :

Typist	Rate per hour (Rs.)	No. of Pages per hour Type	Job	No. of Pages
A	5	12	P	199
B	6	14	Q	175
C	3	8	R	145
D	4	10	S	298
E	4	11	T	178

10. Steel is produced and then stored in warehouses in three cities.

Warehouse Location	Weekly Production (tons)
A	150
B	210
C	320
	680



These plants supply steel to markets in four cities, which have the following demand :

Market Location	Weekly Demand (tons)
1	130
2	70
3	180
4	240
	<b>620</b>

The following shipping costs per ton have been determined :

From \ To	1	2	3	4
A	14	9	16	18
B	11	8	7	16
C	16	12	10	22

Determine the optimal shipping cost and Apply MODI too.

### SECTION—C (2×15)

11. It is game between the two players where A is maximizing player and B is minimising player. Player A wins B's coin if the two coins total are equal to odd number and losses his coin if total of two coins is even. It is game of 1, 2, 5, 10 and 150 rupees coins. Determine the pay off matrix, the best strategies for each player and the value of game to A.

12. The following mortality rates have been observed for a certain type of light bulbs :

End of week	1	2	3	4	5	6
Probability of failure	0.09	0.25	0.49	0.85	0.97	1.00

There are one hundred such bulbs which are to be kept in working order. If a bulb fails in a service, it costs Rs. 3 to replace but if all the bulbs are replaced at once then it costs Rs. 0.70 per bulb.

It is proposed to replace all the bulbs at fixed intervals, whether or not they have burnt out, ones to continue replacing burnt out bulbs as they fail.

What should be the Replacement Policy ?

13. Gupta Bakery Amritsar keeps stock of a popular brand of cake. Daily demand based on past experience is as given below :

Experience indicates

Daily demand	0	15	25	35	45	50
Probability	.01	.15	.20	.50	.12	.02

Consider the following sequence of random numbers :

R. No. 48, 78, 09, 51, 56, 77, 15, 14, 68, 09.

Using the sequence, simulate the demand for the next 10 days.

Find out the stock situation if the owner of the bakery decides to make 35 cakes every day. Also estimate the daily average demand for the cakes on the basis of simulated data.



14. Growfast Company is evaluating four alternative single-period investment opportunities whose returns are based on the state of the economy. The possible states of the economy and the associated probability distribution is as follows :

State	Fair	Good	Great
Probability	0.2	0.5	0.3

The return for each investment opportunity and each state of the economy are as follows :

Alternative	State of Economy		
	Fair (Rs.)	Good (Rs.)	Great (Rs.)
W	1,000	3,000	6,000
X	500	4,500	6,800
Y	0	5,000	8,000
Z	-4,000	6,000	8,500

Using the decision-tree approach, determine the expected return for each alternative. Which alternative investment proposal would you recommend if the expected monetary value criterion is to be employed ?

