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(ii) Questions : 14 Sub. Code : 0839

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Bachelor of Commerce 6th Semester

(2042)

OPERATIONAL RESEARCH

Paper—BCM-605

Time Allowed : Three Hours] **[Maximum Marks : 80**

Note :— Attempt *four* questions from Section A and *two* questions each from Section B and Section C. Use of non-programmable calculator is allowed. Each question in Section A carries **5** marks. Each question in Section B and in Section C carries **15** marks.

SECTION—A

1. Write the dual to the following primal LP problem :

Minimize $Z = 20x_1+15x_2+18x_3+10x_4$

Subject to $4x_1-3x_2+10x_3+4x_4 \leq 60$

$x_1+x_2+x_3=27$

$-x_2+4x_3+7x_4 \geq 35$

$x_1, x_2, x_3 \geq 0$ and x_4 unrestricted in sign

2. Solve graphically the following LPP :

Max. $Z = 3x_1+3x_2$

Subject to $x_1+x_2 \geq 1$

$x_1+x_2 \leq 7$

$x_1+2x_2 \leq 10$

$x_2 \leq 0$

where $x_1, x_2 \geq 0$

3. Solve the following Assignment Problem. The data given in the table refer to production in units.

Operators	Machines A	B	C	D
1	10	5	7	8
2	11	4	9	10
3	8	4	9	7
4	7	5	6	4
5	8	9	7	5

4. A steel company is negotiating with its union for revision of wages to its employees. The management, with the help of a mediator, has prepared a pay-off matrix shown below. Plus sign represents wage increase, while negative sign stands for wage decrease. Union has also constructed a table which is comparable to that developed by management. The management does not have the specific knowledge of game theory to select the best strategy (or strategies for the firm) you have to assist the management on the problem. What game value and strategies are available to the opposing group ?

Additional costs to steel company (Rs.)

		Union Strategies U_1	U_2	U_3	U_4
Company Strategies	C_1	2.50	2.70	3.5	–0.20
	C_2	2.00	1.60	0.80	.50
	C_3	1.40	1.20	1.50	1.30
	C_4	3.00	1.40	1.90	0

5. A machine costs Rs. 10000 operating costs Rs. 500 per year for first five years. In the sixth and succeeding years operating costs increase by Rs. 100 per year. Assuming 10% discount rate of money per year, find the optimum length of time to hold the machine before it is replaced.

6. Choose the list product applying Hurwitz method with coefficient of optimism $\alpha = .60$ to the following data :

State of nature / Acts	Profit (in Rs.) if the market is		
	good	fair	poor
Product A	10000	8000	2000
Product B	12500	9000	–1000

SECTION—B

7. 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 costs Re. 1 per week to feed. Mr. Amit has only Rs. 80 to spend for hens. How many of each kind should Mr. Amit buy to give a profit of at least Rs. 6 per week, assuming that Mr. Amit cannot have more than 20 hens. Solve the linear programming problem graphically.

8. Solve by Simplex :

Max. $Z = 3x_1+2x_2$

Subject to $2x_1+x_2 \leq 2$

$3x_1+4x_2 \geq 12$

$x_1 \geq 0,\ x_2 \geq 0$

9. A company has decided to manufacture some or all of five new products at three of its plants. The production capacity of each of these three plants is as follows :

Plant no.	**Production capacity in total number of units**
1	40
2	60
3	90

Sales potential of the five products is as follows :

Product no.	1	2	3	4	5
Market potential in units	30	40	70	40	60

Plant no. 3 cannot produce product no. 5. The variable cost per unit for the respective plant and product combination is given on the next page.

Product no.	1	2	3	4	5
Plant no. 1	20	19	14	21	16
Plant no. 2	15	20	13	9	16
Plant no. 3	18	15	18	20	

Based on above data determine the optimum product to plant combination. Test optimality by Modi method to minimize cost.

10. A firm marketing a product has four salesmen S_1, S_2, S_3 and S_4. There are three customers to whom a sale of each unit to be made. The chances of making a sale to a customer depend on the salesman customer support. The data depicts the probability with which each of the sales man can sell to each of the customers :

	Salesman			
Customer	S_1	S_2	S_3	S_4
C_1	0.7	0.4	0.5	0.8
C_2	0.5	0.8	0.6	0.7
C_3	0.3	0.9	0.6	0.2

If only one salesman is to be assigned to each of the customers what combination of salesman and customers shall be optimal. Given further that the profit obtained by selling one unit to C_1 is Rs. 500, whereas it is respectively Rs. 450 and Rs. 540 for sale to C_2 and C_3. What is the expected profit ?

SECTION—C

11. Solve the following games :

		Player Q			
		I	II	III	IV
Player P	I	6	4	8	0
	II	6	8	4	8
	III	8	4	8	0
	IV	0	8	0	16

12. A computer has 1000 electronic tubes maximum life of which is 500 hours. The probability of failure at different periods of time is as follows :

Period (100 hours)	Age of failure (hours)	Probability of failure
1	0—100	.10
2	101—200	0.26
3	201—300	0.35
4	301—400	0.22
5	401—500	0.07

Replacement of an individual tubelight failing during service costs Rs. 60 per tube, while in case of group replacement at fixed interval is Rs. 15 per tube.

(i) How the replacement should be done (a) individually or (b) in group ?

(ii) When the tubes should be replaced ?

13. A company manufactures around 200 mopeds. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is as given below :

Production per day	Probability
196	0.05
197	0.09
198	0.12
199	0.14

Production per day	Probability
200	0.20
201	0.15
202	0.11
203	0.08
204	0.06

The finished mopeds are transported in a specially designed three storeyed lorry that can accommodate only 200 mopped. Using the following 15 random numbers 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54, 10, stimulate the process to find out :

(i) What will be the average number of mopeds waiting in the factory ?

(ii) What will be the average number of empty spaces on the lorry ?

14. The investment staff of TNC Bank is considering four investment proposals for a client : shares, bonds, real estate and savings certificate. These investments will be held for one year.

The past data regarding the four proposals are given below :

Shares. There is 25 percent chance that shares will decline by 10 percent, a 30 percent chance that they will remain stable and a 45 percent chance that they will increase in value by 15 percent. Also the shares under consideration do not pay any dividends.

Bonds. These bonds stand a 40 percent chance of increase in value by 5 percent and 60 percent chance to remaining stable and they yield 12 percent.

Real Estate. This proposal has a 20 percent chance of increasing 30 percent in value, a 25 percent chance of increasing in 20 percent value, a 40 percent chance of increasing in 10 percent value, a 10 percent chance of remaining stable and a 5 percent chance of losing 5 percent of its value.

Savings Certificate. These certificates yield 8.5 percent with certainty.

Use a decision tree to structure the alternatives available to the investment staff, and using the expected value criterion, choose the alternative with the highest expected value.