

Note:

1. All questions are **compulsory**.
2. Graph Papers will be provided on request.
3. Figures to the right indicate full marks.
4. Use of non-programmable scientific calculator is allowed.

Q.1 A In a large system containing 1000 similar items, which are subject to failure as follows: 10

Week :	1	2	3	4	5
% failure at the end of the week:	10	20	40	70	100

The cost of individual replacement of a item is Rs.60. If all the items are replaced in a lot then the cost per item is Rs.15. Determine the most economical replacement policy.

OR

B A machine costs Rs. 10000, the maintenance cost is estimated to be Rs. 200 in the first year and it increased by Rs. 400 every succeeding year. Assuming that the machine has no salvage value, and the time value of money is 10% p.a. and maintenance cost are incurred in the beginning of each year find the optimum period of replacement. 10

C Explain various phases of Operations Research. 5

OR

D Explain briefly any five areas of Management where techniques of Operations Research are used. 5

Q.2 A A company has a sales force of 125 men, who operate from three regional offices. The company produces four basic product lines of hand tools. The sales manager feels 30 sales men are needed to distribute product line I, 50 are needed to distribute product line II, 20 for product line III and 25 for product line IV. The cost in Rs. per day for assigning salesmen from each of the offices for selling each of the product lines are as follows: 15

Regional office	Product lines			
	I	II	III	IV
A	25	26	21	23
B	22	33	19	21
C	34	28	24	25

At present 50 salesmen are allocated to office A, 45 salesmen are allocated to office B and 35 salesmen are allocated to office C. find the optimum allocation to minimize total cost.

Identify any one alternate solution if exists.

OR

B Determine the Optimal plan so as to maximize the profit for the following: 15

Plant	Profit per unit				Supply
	Agency				
	A	B	C	D	
1	12	12	6	15	400
2	0	7	1	10	300
3	9	11	7	11	800
Demand	300	400	300	500	

- Q.3 A Is there any alternate plan available? Give reason. 15
- A A firm uses three machines in the manufacturing of three products. Each unit of product A requires 3 hours on machine I, 2 hours on machine II and 1 hour on machine III. Each unit of product B requires 4 hours on machine I, 1 hour on machine II and 3 hours on machine III. Each unit of product C requires 2 hours on each of these three machines. The contribution margin of these three products is Rs. 30, Rs. 40 and Rs. 35 per unit respectively. The machine hours available on three machines are 90, 54 and 93 respectively.
- Formulate the above as Linear Programming Problem.
 - Obtain the optimum solution by simplex method.

OR

- B i) A chemical company manufactures two chemicals A and B. On the basis of the demand the management feels that the total production of these chemicals A and B should be at least 350 Kgs. Moreover a major customer's order for 125 Kgs of chemical A must be supplied. Chemical A requires 2 hours of processing time per Kg and Chemical B requires 1 hour of processing time per Kg. In all 600 hours of processing time is available. The production costs are Rs. 20 per Kg for chemical A and Rs. 30 per Kg. for chemical B. Formulate this as Linear Programming Problem and solve graphically to find optimal product mix and associated total minimum cost of production. 5

- ii) Write the dual of the following linear programming problem:

$$\text{Minimize } Z = 9X_1 + 10X_2$$

subject to

$$3X_1 + 5X_2 \leq 190,$$

$$3X_1 - X_2 = 80,$$

$$X_2 \geq 10,$$

$$X_1 \geq 0, X_2 \geq 0$$

- Q.4 Attempt any three of the following:

- A The data on operating costs per year and resale price of an equipment whose purchase price is Rs. 30000 is as follows: 5

Year	1	2	3	4	5	6
Operating cost (Rs.)	1500	1900	1250	600	400	400
Resale value (Rs.)	25000	22500	21250	20600	20400	20400

Find the optimum period of replacement for the equipment.

- B The following is the initial solution obtained for a transportation problem, test it for optimality and find the optimum solution and the associated cost: 5

Sources	Destinations			Supply
	D ₁	D ₂	D ₃	
S ₁	40	20	210	10
S ₂	80	35	165	30
S ₃	40	190	40	40
Demand	30	30	20	

$$S_1 \rightarrow D_1 = 10, S_2 \rightarrow D_2 = 30, S_3 \rightarrow D_1 = 20, S_3 \rightarrow D_3 = 20$$

C From the following initial simplex tableau write down the original primal L.P.P. represented by the tableau: 5

	C_j	10	12	0	0	M	M	
Basis	C_i	X_1	X_2	S_1	S_2	A_1	A_2	b_j
A_1	M	1	1	0	0	1	0	5
A_2	M	1	0	-1	0	0	1	2
S_2	0	0	1	0	1	0	0	4

D Explain the following in one or two lines : 5

- i) Multiple optimum solutions with reference to L.P.P. and how to identify this in simplex method?
- ii) An unbalanced transportation problem.
- iii) The different situations where the question of replacement is considered.

Q.5 A State whether following statements are true or false : 8

- i) Holistic approach is one of the phases of operations research.
- ii) Infeasibility with respect to L.P.P. solely depends upon the objective function and has nothing to do with the constraints.
- iii) In the standard form of a L.P.P. the right hand side of each constraint must be made non negative if it is not non negative already.
- iv) The variables which can assume positive, negative or zero value are called unrestricted variables.
- v) VAM method is used to check the optimality of the current solution of the transportation problem.
- vi) The degeneracy in transportation problems may occur when there are two or more cells with the smallest negative value in a closed path for incoming cell.
- vii) The negative opportunity cost indicates the per unit cost reduction that can be achieved by raising the shipment allocation in the unoccupied cell from its present value of zero.
- viii) When time value of money is considered, costs needs to be discounted.

B Choose the most appropriate alternative as your answer: 7

- i) A physical model in Operations Research is an example of

 - (a) an iconic model.
 - (b) an analogue model.
 - (c) a verbal model.
 - (d) a mathematical model.

- ii) The solution space of a L.P.P. is unbounded due to _____
- (a) an incorrect formation of L.P. model.
 - (b) objective function is unbounded.
 - (c) neither (a) nor (b).
 - (d) either (a) or (b).
- iii) To formulate a problem for solution by the simplex method, we must add artificial variable to _____
- (a) equality constraints.
 - (b) greater than constraints.
 - (c) both (a) and (b).
 - (d) none of these.
- iv) Which of the following is incorrect?
- (a) A slack variable represents an unused resource.
 - (b) A surplus variable represents the amount by which solution values exceed resource.
 - (c) The infeasible solution is discovered in the final simplex table when all the $C_j - Z_j$ values imply optimal solution but at least one of the artificial variable appears in the basis with positive value.
 - (d) None of these.
- v) The solution to the transportation problem with m rows and n columns is feasible if the number of occupied cells is _____.
- (a) $m + n$
 - (b) more than $m + n - 1$
 - (c) less than $m + n - 1$
 - (d) none of these
- vi) Which of the following is correct with reference to transportation problem?
- (a) Least cost method is used to test optimality of a solution.
 - (b) A closed path will consist of even number of occupied cells.
 - (c) The advantage of using North West Corner rule while finding initial basic feasible solution is that it takes in to consideration the cost factor.
 - (d) None of these.
- vii) The problem of replacement is felt when job performing units fail _____
- (a) suddenly.
 - (b) gradually.
 - (c) both (a) and (b).
 - (d) none of these.

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