Total Marks: 75

(2 ½ Hours)

1) All questions are Compulsory.

N.B.

- 2) Figures to the right indicate full marks.
 - 3) Graph papers will be supplied on request.
 - 4) Use of non programmable scientific calculator is allowed.
- Q 1. The following mortality rates have been observed for a certain type of electronic a) part in a car.

Week	1	2	3	4	5
Number of parts failing at the end of the week	150	300	1050	2250	3000

There are 3000 such electronic parts. It costs Rs. 50 to replace an individual part. If all parts are to be replaced at a time it would cost Rs. 30 per part. It is proposed to replace all these parts at fixed intervals of time, whether or not they have burnt out, and to continue replacing the burnt out parts as they fail. At what intervals the group replacement should be made?

(OR)

- A machine X costs Rs. 80000. Its maintenance cost is Rs.2000 in the first year and 10 b) then increases by Rs. 4000 in each successive year. Another machine Y costs Rs. 50000 whose replacement period is every nine years with average running cost of Rs.20420. Time value of money is 10% per annum. Assuming the salvage to be negligible, Find optimum replacement time for Machine X. Which of the two should be preferred? Assume scrap value to be zero.
- 5 c) Mention any five short comings of Operations Research. (OR) d) State 5 areas of applications in operations research. 5
- Q 2. a) Solve the following transportation problem to maximize profit

Origin	(Pro	Supply			
	D ₁	D ₂	D ₃	D_4	
O ₁	70	55	52	63	1000
O ₂	74	65	60	60	300
O ₃	68	68	58	60	700
Demand	400	200	600	300	

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b) A company has 3 terminals and 4 plants, the dispatcher has estimated the costs as well as initial transportation schedule between terminals and plants as follows: 15

Torminal	P	roject	Avoilability		
Terminar	P1	P2	P3	P4	Availability
T1	20	36	10	28	1000
T2	40	20	45	20	400
T3	75	35	45	50	600
Requirement	300	400	800	500	

Solve the above transportation Problem to minimize the total cost.

Q 3. a) A company has three products X, Y and Z out of three raw materials A,B and C. **15** The raw material requirement is given below:

Dourmotoriala	Number of units required /unit				
Raw Illaterials	Х	Y	Z		
A	1	2	1		
В	2 1		4		
C	2	5	1		

The unit profit contribution of the products X, Y, Z is Rs. 40, 25, 50 respectively. The number of units of raw materials available are 36, 60 and 45 respectively. Determine the product mix that will maximize the total profit.

(OR)

b) i) A firm plans to purchase at least 200 Kg of scrap containing high quality metal H and low quality metal L. It decides that scrap to be purchased must contain at least 100 Kg of H and not more than 35 Kg of L. The firm can purchase the scrap from two suppliers S1 and S2 in unlimited quantities. The percentage of H and L in terms of weight in the scrap supplied is given below:

Metals	Supplier S1	Supplier S2
Н	25%	75%
L	10%	20%

The price of S1's scrap is Rs.2000 per Kg and that of S2's is Rs.4000 per Kg. Formulate this as LPP and solve graphically.

ii) Write the dual of the following LPP Minimize $Z = 22x_1+14x_2+14x_3$ Subject to $3x_1+x_2+3x_3 \ge 1$, $2x_2+2x_3 = 4$, $x_1 \ge 0$, $x_2 \ge 0$ $x_3 \ge 0$

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Q 4. Attempt any 3 of the following:

a) A company has 3 factories at A,B and C which supply to warehouses D,E, F and G. Monthly production capacities of these factories are 250,300 and 400 units respectively. The current warehouse requirements are 200, 275,175 and 300 units respectively. The unit transportation costs from factories to warehouses are as follows:

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То	From					From		
10	Α	С						
D	11	16	21					
E	13	18	24					
F	17	14	13					
G	14	10	10					

Find the initial feasible solution using Least cost method and what can you say about the solution?

b) A transport company buys trucks costing 50000 each. From the data below advise **5** the management when the truck should be replaced.

Year	1	2	3	4	5	6
Operating cost	7500	8000	8500	9000	10000	12250
Resale price (in Rs.)	45000	40500	37500	36000	34500	33250

c) The Simplex Table for a Maximization Linear programming is given below:

Cj	Product mix	X 1	X2	S 1	S 2	Quantity
5	X2	1	1	1	0	10
0	S 2	1	0	-1	1	3
	Cj	4	5	0	0	

Answer the following questions, giving reasons in brief: is the above solution i) optimum? Ii) feasible? iii) unique? iv) If s_1 is slack of machine A (in hours/week) ans s_2 is that of Machine B which of these machines is utilized to the fullest capacity as per the above solution?

- d) Explain the following in one or two lines:
 - i) Slack and Surplus variable with reference to Linear programming problem.
 - ii) Opportunity cost with reference to transportation problem.
 - iii) Mention various types of replacement models.
- Q 5. a) State whether the following are true are false:
 - i) If primal linear programming problem has 3 variables, then dual linear programming problem must have 2 constraints.
 - ii) If an artificial variable is present in the basic variable column of optimal simplex table, then the problem has infeasible solution.
 - iii) Operations Research was known as an ability to win a war without really going in to a battle field.

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- iv) A transportation problem is said to be unbalanced if m+n-1 is not same as number of allocated cells.
- v) MODI method is one of the methods used for finding the initial feasible solution for a transportation problem.
- vi) A basic feasible solution of a LPP is said to be degenerate if at least one of the basic variable is zero
- vii) When time value of money is considered the cost needs to be discounted.
- viii) Replacement model is a static model.
- b) Choose the best possible alternative for each of the following:
 - i) Operations research is the application of ______methods to arrive at the optimal solutions to the problems.
 a) economical b) scientific c) (a) and (b) both d) artistic
 - ii) The dummy source or destination in a transportation problem is added to
 a) ensure that total cost does not exceed a limit
 b) prevent solution from becoming degenerate c) satisfy rim condition
 d) None of the above
 - iii) Group replacement policy is suitable for identical low cost items which are likely toa) Fail over a period of time. b) Fail suddenly c) Fail at a fixed interval of time d) None of the above.
 - iv) Sudden failure among items is seen asa) Progressiveb) Retrogressivec) Randomd) All of these.
 - v) A solution for a transportation problem will be optimum and unique if in all unoccupied cells
 a) c_{ij}-(u_i+v_j) < 0 b) c_{ij}-(u_i+v_j) > 0 c) c_{ij}-(u_i+v_j) ≥0 d) None of these
 - vi) For a maximization problem, the objective function coefficient for an artificial variable is
 a) M
 b) -M
 c) Zero
 d) 1
 - vii) In graphical method the restriction on number of constraints is ______.a) 2 b) 3 c) not more than 3 d) none of these