



Name :

Roll No. :

Invigilator's Signature :

CS/MBA (New)/SEM-4 (PT)/MB-302/2010

2010

OPERATIONS RESEARCH

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Graph sheet(s) will be provided by the Institution.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

i) Software used in OR is

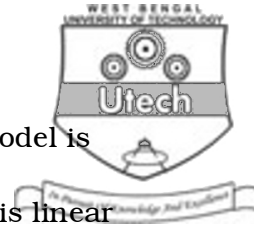
a) Quantitative System for Business Plus (QSB +)

b) Quantitative System for Operations Management

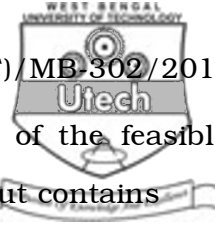
(QSOM)

c) M.S. Excel

d) all of these.



- ii) The distinguishing feature of an LP model is
- a) relationship among all variables is linear
 - b) it has single objective functions & constraints
 - c) value of decision variable is non-negative
 - d) all of these.
- iii) An Iso-profit line represents
- a) an infinite number of solutions all of which yield the same profit
 - b) an infinite number of solutions all of which yield the same cost
 - c) an infinite number of optimal solutions
 - d) a boundary of the feasible region.
- iv) To convert \geq inequality constraints into equality constraint, we must
- a) add a surplus variable
 - b) subtract an artificial variable
 - c) subtract a surplus variable & add an artificial variable
 - d) add a surplus variable & subtract an artificial variable.



- v) In the cutting plane method, the part of the feasible solution space eliminated by plotting a cut contains
- a) only non-integer solutions
 - b) only integer solutions
 - c) both (a) and (b)
 - d) none of these.
- vi) If for a given LPP, a slack variable is equal to zero then
- a) the solution is optimal
 - b) the solution is not feasible
 - c) the entire amount of resources with the constraint in which the slack variable appears has been consumed
 - d) the solution has multiple solutions.
- vii) If the dual has an unbounded solution, the primal LPP has
- a) no feasible solution
 - b) unbounded solution
 - c) multiple solution
 - d) one feasible solution.



- viii) If at the optimality a primal constant has positive value of slack variable, then
- a) the dual variable corresponding to that constraint has zero value
 - b) corresponding resource is not completely used up
 - c) corresponding resource has zero opportunity cost
 - d) corresponding resource is not completely used up and also it has zero opportunity cost.
- ix) The optimal solution for a maximization problem in LPP is obtained when
- a) all $c_j - z_j \leq 0$
 - b) some of $c_j - z_j \leq 0$
 - c) $c_j - z_j \geq 0$
 - d) none of these.
- x) Non-degenerate solution is obtained if there are allocations in
- a) $m + n - 1$ cells
 - b) $m + n$ cells
 - c) $m + 1 - n$ cells
 - d) none of these.
- xi) A transportation problem is said to be unbalanced if
- a) total supply = total demand
 - b) total supply \neq total demand
 - c) total demand \leq total supply
 - d) total demand \geq total supply.
- xii) An assignment problem can be solved by
- a) Hungarian method
 - b) VAM
 - c) Simplex method
 - d) none of these.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What is shadow price ? How does the concept relate to the dual of an LP problem ?
3. An animal feed company must produce 200 kgs of a mixture containing the ingredients X and Y. X costs Rs. 3 per kg and Y costs Rs. 8 per kg. Not more than 80 kgs of X can be used and minimum quantity to be used of Y is 60 kgs. Formulate the problem as an L.P.P. Write the dual of the same problem.
4. A company is considering an expansion into five new sales territories. The company has recruited four new salesmen. Based on the salesmen's experiences and personality the sales manager has assigned a rating to each of the salesmen for each of the sales territories. The ratings are as follows :

		TERRITORIES				
		1	2	3	4	5
SALESMEN	S1	75	80	85	70	90
	S2	91	71	82	75	85
	S3	78	90	85	80	80
	S4	65	75	88	85	90

Suggest optimum assignment of the salesmen. If for certain reasons, salesman S4 cannot be assigned to territory 3, will the optimum assignment be different ? If so, what would be the new assignment schedule ?



5. The marketing department of a company has to decide on the following types of shampoo to be launched under the following estimated pay-offs (in million of rupees) for the various levels of sales :

Types of Shampoo	Estimated level of sale (units)		
	15000	10000	5000
Egg shampoo	30	10	10
Clinical shampoo	40	15	5
Deluxe shampoo	55	20	3

What will be the marketing manager's decision if

- a) Maximin
- b) Maximax
- c) Laplace principle

is adopted ?

6. Given below is a transportation problem in which the cells contain the unit transportation costs in rupees. Find the initial solution by using

- a) North West corner rule
- b) Least cost method.

	D_1	D_2	D_3	D_4	Supply
O_1	1	2	3	4	6
O_2	4	3	2	0	8
O_3	0	2	2	1	10
Demand	4	6	8	6	24



7. Find the dual of the following primal problem :

Maximize $Z = 3x_1 - x_2 + x_3$

subject to $4x_1 - x_2 \leq 8$

$$8x_1 + x_2 + 3x_3 \geq 12$$

$$5x_1 - 6x_3 \leq 13$$

$$x_1, x_2, x_3 \geq 0.$$

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

8. a) A manufacturing company has four zones A, B, C & D and four sales engineers P, Q, R & S respectively for assignment. Since the zones are not equally rich in sales potential, it is estimated that a particular engineer operating in a particular zone will bring the following sales :

Zone A : 4,20,000; Zone B : 3,36,000;

Zone C : 2,94,000; Zone D : 4,62,000.

The engineers are having different sales ability. Working under the same conditions their yearly sales are proportional to 14, 9, 11, 8 respectively. The criteria of maximum expected total sales are to be met by assigning the best engineer to the richest zone, the second best to the next richest zone and so on. Find the optimum assignment and the maximum sales.



b) Solve the following L.P.P. by Big-M method :

$$\text{Maximize } Z = 2x - 3y$$

$$\text{subject to } -x + y \geq -2$$

$$5x + 4y \leq 46$$

$$7x + 2y \geq 32$$

$$x, y \geq 0.$$

8 + 7

9. Find all integer solution of the following L.P.P. :

$$\text{Maximize } Z = 2x + 3y$$

$$\text{subject to } 3x + 4y \leq 12$$

$$x + 3y \leq 6$$

$$x, y \geq 0, x \text{ and } y \text{ are integers.}$$

10. a) Solve the following L.P.P. by using Graphical solution method :

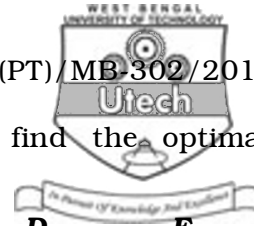
$$\text{Maximize } Z = 4x_1 + 3x_2$$

$$\text{subject to } 2x_1 + x_2 \leq 1000$$

$$x_1 + x_2 \leq 800$$

$$x_1 \leq 400 \text{ and } x_2 \leq 700$$

$$\text{and } x_1, x_2 \geq 0.$$



b) Solve the assignment problem to find the optimal assignments :

	A	B	C	D	E
P	11	17	8	16	20
Q	9	7	12	6	15
R	13	16	15	12	16
S	21	24	17	28	26
T	14	10	12	11	15

c) Define stochastic process, stationary process, Markov process and Markov chain. 5 + 6 + 4

11. a) Find the optimal (minimum) solution of the following transportation problem :

		Destination				Availability
		D_1	D_2	D_3	D_4	a_i
	O_1	23	27	16	18	30
Origin	O_2	12	17	20	51	40
	O_3	22	28	12	32	53
Demand	b_i	22	35	25	41	

b) A road transport company has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservations. Customers arrive at a rate of 8 per hour and the clerk can service

12 customers on an average per hour. After stating your assumptions, answer the following :

- i) What is the average number of customers waiting for the service of the clerk ?
- ii) What is the average time a customer has to wait before getting service ? 10 + 5

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12. a) XYZ Airline operating 7 days a week has given the following time table. Crews must have a minimum layover of 5 hours between flights. Obtain the pairing flights that minimize layover time away from the home. For any given pairing the crew will be based at the city that results in the smaller layover :

Dia.

- b) Solve the following linear goal programming problem graphically. Find x_1 , x_2 so as to

Minimize Dia.

And satisfy the goals :

Dia.

The goals have been listed in order of priority. 8 + 7



13. a) Explain the concept of Transition Probabilities in Markov Analysis.

b) The School of International Studies for Population found out by its survey that the mobility of the population (in per cent) of a state to a village, town and city is in the following percentages :

		<i>To</i>		
		<i>Village</i>	<i>Town</i>	<i>City</i>
<i>From</i>	<i>Village</i>	50	30	20
	<i>Town</i>	10	70	20
	<i>City</i>	10	40	50

What will be the proportion of population in village, town and city after two years, given that the per cent population has proportions of 0.7, 0.2 and 0.1 in the village, town and city, respectively ? 5 + 10

