2012

OPERATIONS RESEARCH

Paper : 205

(Old Syllabus)

Full Marks : 70

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer *any* **five** questions

1. *(a)* Discuss two applications of Operation Research techniques. 6

(b) A factory is engaged in manufacturing two products, *A* and *B* which involve lathe work, grinding and assembling. The cutting, grinding and assembling times required for one unit of *A* are 2, 1 and 1 hour respectively and for one unit of *B* are 3, 1 and 3 hours respectively. The profit on each unit of *A* and *B* are Rs 2 and Rs 3 respectively. Assuming that 300 hours of cutting time, 300 hours of grinding time and 240 hours of assembling time are available, solve the problem in terms of maximizing the profit on the items manufactured. 8

2. *(a)* Define slack and surplus variables in a linear programming problem. 4

(b) What do you understand by the term 'Sensitivity Analysis'? 4

(c) Obtain the dual problem of the following primal LP problem :

Minimize $Z = x_1 + 2x_2$

subject to the constraints

$$2x_1 + 4x_2 \leq 160$$
$$x_1 - x_2 = 30$$
$$x_1 \geq 10$$
$$x_1, x_2 \geq 0$$

3. *(a)* What is meant by unbalanced transportation problem? What treatment is made to such a problem? 5

(b) A company has three plants and four warehouses. The supply and demand in units and the corresponding transportation costs are given. The table below gives the solution of this problem :

Warehouses

	I	*II*	*III*	*IV*	*Supply*
Plant A	5	10	4 (10)	5	10
Plant B	6 (20)	8	7	2 (5)	25
Plant C	4 (5)	2 (10)	5 (5)	7	20
Demand	25	10	15	5	55

(Continued)

Answer the following questions, giving brief reasons for the same : 1+1+2+2+3=9

(i) Is this solution feasible?

(ii) Is this solution degenerate?

(iii) Is this solution optimal?

(iv) Does this problem have more than one optimum solution? If so, what is the alternate optimal solution?

(v) If the cost for route B–III is reduced from Rs 7 to Rs 6 per unit, what will be the optimal solution?

4. *(a)* A department of a company has five employees with five jobs to be performed. The time (in hours) that each man takes to perform each job is given in the following matrix : 7

Employees

Jobs	*I*	*II*	*III*	*IV*	*V*
A	10	5	13	15	16
B	3	9	18	13	6
C	10	7	2	2	2
D	7	11	9	7	12
E	7	9	10	4	12

How should the jobs be allocated so as to minimize the total time?

(Turn Over)

(b) Solve the following integer programming problem using the graphical procedure : 7

Maximize $Z = 10x_1 + 20x_2$

subject to

$$6x_1 + 8x_2 \leq 48$$

$$x_1 + 3x_2 \leq 12$$

$x_1, x_2 \geq 0$, and integers

5. (a) Find an optimal sequence for the following sequencing problems of four jobs and five machines. Its processing time (in hours) is given below :

		Machines				
		M_1	M_2	M_3	M_4	M_5
Jobs	A	7	5	2	3	9
	B	6	6	4	5	10
	C	5	4	5	6	8
	D	8	3	3	2	6

Also find the total elapsed time. 8

(b) A project consists of nine activities. The duration of these activities and their interdependence relationship is given in the table that follows :

Activity	Immediate Predecessors	Time (in days)
A	—	5
B	A	7
C	B	2
D	B	3
E	C	1
F	D	2
G	C	1
H	E, F	3
I	G, H	10

Draw the network and indicate the critical path. What is the project duration? 6

6. (a) A bakery keeps stock of a popular brand of cake. Previous experience shows the daily demand pattern for the item with associated probabilities as given below :

Daily Demand (in Nos.)	:	0	10	20	30	40	50
Probability	:	0·01	0·20	0·15	0·50	0·12	0·02

Use the following sequence of random numbers to simulate the demand for the next 10 days :

25, 39, 65, 76, 12, 05, 73, 89, 19, 49

Also estimate the daily average demand for the cakes on the basis of the simulated data. 8

(b) When asked to compare three soft drinks with respect to flavour, an individual stated that—

(i) A is moderately more preferable than B

(ii) A is equally to moderately more preferable than C

(iii) B is strongly more preferable than C

Set up the pairwise comparison matrix for this problem. 6

7. *(a)* An office equipment manufacturer produces two types of products : Chairs and Desks. The production of either a chair or a desk requires one hour of production capacity in the plant. The plant has a maximum production capacity of 50 hours per week. Because of the limited sales capacity, the maximum number of chairs and desks that can be sold are 6 and 8 per week respectively. The gross margin from the sales of a chair is Rs 90 and from the sale of a desk is Rs 60. The plant manager desires to determine the number of units of each product that should be produced per week in consideration of the following set of goals :

Goal 1 : Available production capacity should be utilized as much as possible but should not exceed 50 hours per week.

Goal 2 : Sales of two products should be as much as possible.

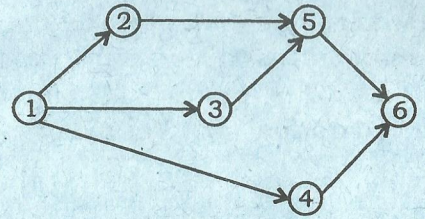
Goal 3 : Overtime should not exceed 20 per cent of available production time.

Formulate the above problem as a goal programming problem. 7

(Continued)

(b) A small project comprises of seven activities as represented by the given network diagram. The activity time estimates are as follows :

Activity	:	1-2	1-3	1-4	2-5	3-5	4-6	5-6
Optimistic time (in weeks)	:	1	1	2	1	2	2	3
Most likely time (in weeks)	:	1	4	2	1	5	5	6
Pessimistic time (in weeks)	:	7	7	8	1	14	8	15



(i) Determine the expected activity duration and variance. What is the expected project length?

(ii) What is the probability that the project will be completed at least 4 weeks earlier than expected completion time? 7

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