2008

OPERATION RESEARCH

Paper : 205

Full Marks - 70

Pass Marks - 28

Time - Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 7 and any *four* from the rest.

1. (a) The marketing manager of 'Shine and Glow' is interested to determine how many advertisements to release in the selected three magazines A, B and C. His main purpose is to advertise in such a way that total exposure to principal buyers of his goods is maximised. The percentage of readers for each magazine are known. Exposure in any particular magazine is the number of advertisements released multiplied by the number of principal buyers. The following data are available :

	A	B	C
Readers (in lakhs)	1.0	0.6	0.4
Principal Buyers	20%	15%	8%
Cost per advertisement	8,000	6,000	5,000

The budgeted amount is at the most Rs. 1.0 lakh for the advertisements. The manager has already decided that magazine A should have not more than 15 advertisements and that B and C should get at least 8 advertisements. Formulate a Linear Programming Model for this problem.

(b) Solve the following LPP using the Graphical Method.

Maximise $Z = 6x + 8y$

Subject to

$$2x + 3y \leq 16$$
$$4x + 2y \leq 16$$
$$y \leq 8$$
$$x, y \geq 0$$

2. (a) How are the dual variables related to the decision variables in the economic sense?

(b) Given

Minimise $Z = 12x_{11} + 8x_{12} + 2x_{13} + 9x_{21} + x_{22} + 9x_{23} + 7x_{31} + 15x_{32} + 6x_{33}$

Subject to

$$\left. \begin{array}{l} x_{11} + x_{12} + x_{13} = 40 \\ x_{21} + x_{22} + x_{23} = 30 \\ x_{31} + x_{32} + x_{33} = 30 \end{array} \right\} \text{Supply constraints}$$

$$\left. \begin{array}{l} x_{11} + x_{21} + x_{31} = 20 \\ x_{12} + x_{22} + x_{32} = 50 \\ x_{13} + x_{23} + x_{33} = 30 \end{array} \right\} \text{Demand constraints}$$

$$x_{ij} \geq 0, \; i = 1, 2, 3 \; ; \; j = 1, 2, 3$$

Formulate and solve it as a transportation for optimal transportation pattern.   9

3. (a) Use simplex method to solve the following LPP.   9

Maximize $Z = 4x_1 + 5x_2 + 8x_3$

Subject to $x_1 + x_2 + x_3 \leq 100$

$$3x_1 + 2x_2 + 4x_3 \leq 500$$

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

(b) Find the sequence that minimises the total elapsed time required to complete the following jobs on machines M_1, M_2 and M_3 in the order M_1, M_2, M_1.   5

Job :	A	B	C	D	E	F
M_1 :	8	3	7	2	5	1
M_2 :	3	4	5	2	1	6
M_3 :	8	7	6	9	10	9

Also find the total elapsed time.

4. (a) Four operators O_1, O_2, O_3 and O_4 are ▮▮▮
a manager who has to get four jobs ▮▮▮
J_4 done by assigning one job to ▮▮
Given the time needed by different ▮
different jobs in the matrix below :

	J_1	J_2	J_3	J_4
O_1	12	10	10	
O_2	14	12	15	11
O_3	6	10	16	4
O_4	8	10	9	

(i) How should the manager assign the ▮▮▮
that the total time needed for all four ▮▮▮
minimum ?

(ii) If job J_2 is not to be assigned to oper▮▮ ▮
what should be the assignment ?

(b) A company produces three items A, B ▮▮
Production of one unit of A requires ▮
while production of a unit of B and ▮▮
respectively, 3 and 1 hours. The regular ▮▮
capacity is 40 hours per week. The ma▮▮▮▮
department has informed that the maximu▮
per week of A, B and C is 10, 10 a▮ 1▮
respectively. The chief executive of the ▮▮▮▮
has established the following goals accor▮▮▮
their importance.

(i) Avoid any under utilisation of production capacity.

(ii) Meet the order of ABC stores for 7 units of B and 5 units of C per week.

(iii) Avoid the overtime operation of the plant beyond 10 hours.

(iv) Achieve the sales goal of 10 units of A, 10 units of B and 12 units of C.

(v) Minimise the overtime operation as much as possible.

Formulate this as a goal programming problem. 7

5. (a) Discuss a technique to solve multi-criteria decision problem. 7

(b) Discuss how one deals with 'degeneracy' in a transportation problem. 7

6. (a) What is simulation ? Illustrate how you would use Monte Carlo simulation in a situation of queueing. 3+6=9

(b) What is integer linear programming ? Do you agree that it may not be possible to obtain an optimal integer solution by rounding off a continuous optimal solution of a LPP ? If yes, why ? 3+2=5

7. (a) One of the activities in a PERT network has an estimated duration of 17 weeks and a pessimistic 16 weeks. The most likely duration of the activity is shown to be 16 weeks. It can then be concluded that the estimates of the optimistic and most likely durations would respectively be

(i) 12 and 20 weeks

(ii) 7 and 31 weeks

(iii) 5 and 28 weeks.

(b) The data for a project are :

Activity	Preceding Activity	Time (in weeks) Normal	Crash	Cost in Normal	Crash
A	—	3	2		
B	—	8	6		
C	B	6	4		
D	B	5	2		
E	A	13	10		
F	A	4	4		
G	F	2	1		
H	C, E, G	6	4		
I	F	2	1		

(i) Draw a project network diagram and find the critical path.

(ii) Crash the project duration to 17 weeks.