2009

OPERATION RESEARCH

Paper : 205

Full Marks - 70

Time - Three hours

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

Answer any *five* from the following.

1. (a) Mr. Pandey, the marketing manager of ABC Co. is trying to decide on how to allocate his salesmen to the three markets of the company. Market 1 is an urban area and the salesmen can sell, on an average 40 washing machines a month. Salesmen in the other two markets can sell, on an average 36 and 25 washing machines per month respectively. For the coming week, 3 of the salesmen will be on vacation, leaving only 12 men available for duty. Also because of the lack of

company cars, maximum of 5 salesmen can be allocated to market area 1. The selling expenses per week per salesman in each area are Rs. 800 per week for area 1 ; Rs. 700 per week and Rs. 500 per week for area 2 and 3 respectively. The budget for the next week is Rs. 7500. The profit margin per machine is Rs.150.

Formulate a linear programming model to determine how many salesmen should be assigned to each area in order to maximize profits.   6

(b) Solve the following LPP graphically :   8

Maximize $Z = 0.07x_1 + 0.10x_2$

Subject to

$$x_1 + x_2 \leq 30000$$
$$x_1 \geq 6000$$
$$x_2 \leq 12000$$
$$x_1 - x_2 \geq 0$$
$$x_1, x_2 \geq 0$$

2. Formulate the dual of the following LPP and solve the dual using the Simplex Method. Also find the solution to the Primal from the Dual solution.   3+9+2=14

Minimize Subject to

$$Z = 90x_1 + 54x_2 + 93x_3$$

$$3x_1 + 2x_2 + x_3 \geq 30$$
$$4x_1 + x_2 + 3x_3 \geq 40$$
$$2x_1 + 2x_2 + 2x_3 \geq 35$$
$$x_1, x_2, x_3 \geq 0$$

(a) A company is spending Rs. 1200 on transportation of its units from three plants to four distribution centres. The supply and demand of units with unit cost of transportation are :

Plants	Distribution centres				Supply
	D_1	D_2	D_3	D_4	
P_1	20	30	50	17	7
P_2	70	35	40	60	10
P_3	40	12	60	25	18
Demand	5	8	7	15	

What can be the maximum saving by optimal scheduling ?   7

(b) A firm produces four products. There are four operators who are capable of producing any of these four products. The firm operates 8 hours a day and allows 30 minutes for

lunch. The processing time in minutes and the profit for each of the products are given below :

Operator	Products			
	A	B	C	D
1	15	9	10	6
2	10	6	9	6
3	25	15	15	9
4	15	9	10	10
Profit (Rs.) (per unit)	8	6	5	4

Find the optimal assignment of products to operators. 7

4. (a) ANG Investment Services must develop an investment portfolio for a new client. As an initial investment strategy, the new client would like to restrict the portfolio to a mix of two stocks.

Stock	Price/Share (Rs.)	Estimated annual return (%)
AGA products	50	6
Ignite Oil	100	10

The client has Rs. 50,000 to invest and has established the following two investment goals.

Priority Level 1 Goal

Goal 1 : Obtain an annual return of at least 9%.

Priority Level 2 Goal

Goal 2 : Limit the investment in Ignite Oil, the riskier investment, to no more than 60% of total investment.

Formulate a goal programming model for the ANG Investment problem. 8

(b) With the help of the following example, describe the algorithm for solving an 'n-job, 3 machines' sequencing problem. 6

Processing Time

Job	Machine A	Machine B	Machine C
1	3	3	5
2	8	4	8
3	7	2	10
4	5	1	7
5	2	5	6

5. **(a)** A project has the following characteristics

$3+2+5$

Activity	Preceding activity	Completion (Weeks)
A	–	5
B	A	2
C	A	6
D	B	12
E	D	10
F	D	9
G	D	5
H	B	9
I	C, E	1
J	G	2
K	F, I, J	3
L	K	9
M	H, G	7
N	M	8

(i)   Draw a network for this project.

(ii) Find the Critical Path and the Project Completion time.

(iii) Prepare an activity schedule having the ES, EF, LS, LF and total float for each activity.

(b) Describe the travelling salesmen problem.

4

6. (a) Find the optimal solution to the following integer programming problem using Gomory's Cutting Plane method.   7

Maximize $Z = 7x_1 + 9x_2$

Subject to $-x_1 + 3x_1 \le 18$

$7x_1 + x_2 \le 105$

x_1, x_2 are non-negative integers.

(b) In the PERT Network given below, the parentheses contain the most optimistic, most likely and the most pessimistic time estimates of the respective activities. The time estimates are in weeks.   7

PERT NETWORK
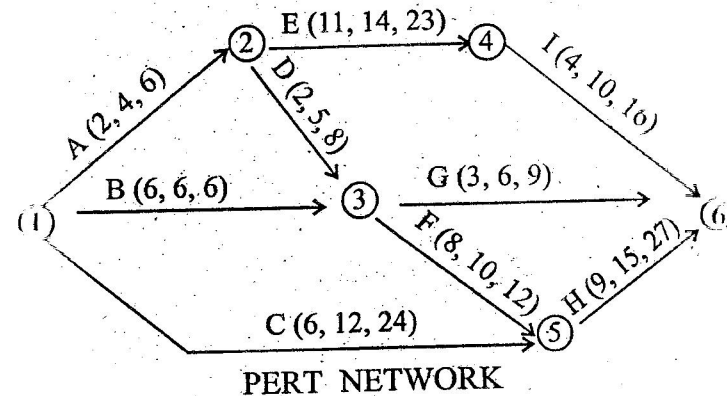
(i) What is the expected project completion time and its variance ?

(ii) What is the probability of completing the project one week before the expected completion time ?

7. Write short notes on any *two* of the following

7×1

(i) Sensitivity analysis in linear programming

(ii) An application of Monte Carlo simulation

(iii) Resource levelling

(iv) Analytical Hierarchy Process.