25(2) OPRE 208

2014

OPERATIONS RESEARCH

Paper : 208

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) Discuss the application of Operation Research Models to production, marketing and finance. 7

(b) A pharmaceutical company has developed a new pill to be taken by smokers. This new pill is a combination of four ingredients that are costly and limited in supply. The available supply and costs are as follows :

Ingredient	Supply	Cost (Rs/kg)
1	22	280
2	18	250
3	20	520
4	24	260

Blending requirements for this new pill is as follows :

(i) Ingredient 1 must be at least 45 per cent of the total quantity but cannot exceed 60 per cent of the total.

(ii) The combined percentage of ingredients 2 and 3 cannot exceed 25% of the total.

(iii) Ingredient 4 must not be more than 50% of the total quantity. Additionally, at least 25 kg of the pill must be produced.

Formulate this problem as an LP model to determine optimum blending requirements at the minimum cost. 7

2. (a) A firm has a given product-mix, determined by the application of Simplex method. It is planning to introduce a new product with a certain profit rate and known requirement of resources already in use. How would you decide whether or not should this product be introduced ? 2

(b) Solve the following LPP using Simplex method 12

Minimize $Z = 600x_1 + 500x_2$

Subject to the constraints

$$2x_1 + x_2 \geq 80$$

$$x_1 + 2x_2 \geq 60$$

$$x_1, x_2 \geq 0$$

3. (a) Solve the following Integer programming problem using the graphical method. 7

Maximise $Z = 14x_1 + 16x_2$

Subject to

$$4x_1 + 3x_2 \leq 12$$

$$6x_1 + 8x_2 \leq 24$$

$$x_1, x_3 \geq 0 \text{ and are integers.}$$

(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 has been taken from the solution procedure of a transportation problem 7

WAREHOUSES

PLANTS		I	II	III	IV	Supply
	A	5	10	4	5	10
	B	6	8	7	2	25
	C	4	2	5	7	20
DEMAND		25	10	15	5	

Answer the following questions, giving brief reasons for the same

(i) Is the solution degenerate ?

(ii) Is the solution feasible ?

(iii) Is the solution optimal ?

(iv) Does the problem have more than one optimal solution ?

4. (a) A department of a company has five employees with five jobs to be performed. The time (in hrs) 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 ?

(b) A company manufactures around 200 mopeds. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is as given below : 7

Production / Day :	196	197	198	199	200	201	202	203	204
Probability :	0·05	0·09	0·12	0·14	0·20	0·15	0·11	0·08	0·06

The finished mopeds are transported in a specially designed lorry that can accommodate only 200 mopeds. Using the following 10 random numbers : 82, 89, 78, 24, 53, 61, 18, 45, 23, 50 simulate the mopeds waiting in the factory

(i) What will be the average number of mopeds waiting in the factory ?

(ii) What will be the number of empty spaces in the lorry ?

(ii) A firm produces two products A and B. Each product must be processed through two departments, namely 1 and 2. Department 1 has 30 hours of production capacity per day, and Department 2 has 60 hours. Each unit of product A requires 2 hours in Department 1 and 6 hours in Department 2. Each unit of product B requires 3 hours in Department 1 and 4 hours in Department 2. Management has fixed the following goals it would like to achieve in determining the daily product mix :

Goal 1 : Minimize the underachievement of joint total production of 10 units

Goal 2 : Minimize the underachievement of producing 7 units of product B.

Goal 3 : Minimize the underachievement of producing 8 units of product A.

Formulate this problem as a Goal programming model. 7

(b) Explain the concept of 'dominance' in game theory using an example.

Also state the formula under the analytical method for solving a game with mixed strategy.

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6. (a) The owner of a chain of fast food restaurants is considering a new computer system for installation. The following information has been gathered with respect to the installation

ACTIVITY	IMMEDIATE PREDECESSOR	TIME (DAYS)		
		PESSIMISTIC	MOST LIKELY	OPTIMISTIC
A	—	4	6	8
B	A	5	7	15
C	A	4	8	12
D	B	15	20	25
E	B	10	18	26
F	C	8	9	10
G	E	4	8	12
H	D, F	1	2	3
I	G, H	6	7	8

(i) Construct the network diagram for the product.

(ii) Determine the critical path and compute the expected completion time.

(iii) Determine the probability of completing the project in 55 days. 8

(b) Use an example to show how the Pairwise Comparison Matrix is formed in AHP (Analytical Hierarchy Process). 6

7. The following table gives data on normal time, normal cost, crash time and crash cost for a project

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ACTIVITY	NORMAL		CRASH	
	Time (Weeks)	Cost (Rs.)	Time (Weeks)	Cost (Rs.)
1-2	3	300	2	400
2-3	3	30	3	30
2-4	7	420	5	580
2-5	9	720	7	810

ACTIVITY	NORMAL		CRASH	
	Time (Weeks)	Cost (Rs.)	Time (Weeks)	Cost (Rs.)
3-5	5	250	4	300
4-5	0	0	0	0
5-6	6	320	4	410
6-7	4	400	3	470
6-8	13	780	10	900
7-8	10	1000	9	1200

Indirect cost is Rs. 50 per week.

(i) Draw the network diagram for the project and indentify the critical path.

(ii) What is the normal project duration and associated cost ?

(iii) Crash the relevant activities systematically and determine the optimal project completion time and cost.

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