

**OPERATIONS RESEARCH**

Time: 3 hours

Max Marks: 60

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) What is the scope of operations research?  
(b) "Model building is the essence of the operation research approach". Discuss.
- 2 (a) A company sells two different products A and B, making a profit of Rs 40 and Rs 30 per unit respectively. They are both produced with the help of a common production process and are sold in two different markets. The production process has a total capacity of 30,000 man-hours. It takes three hours to produce a unit of A and one hour to produce a unit of B. The market has been surveyed and company officials feel that the maximum number of units of A that can be sold is 8,000 units and that of B is 12,000 units. Subject to these limitations, products can be sold in any combination. Formulate this problem as an LP model to maximize profit.

- (b) Comment on the solution of the following LP problem

$$\begin{aligned} \text{Max } Z &= 4X_1 + 4X_2 \\ \text{Subject to } X_1 + 2X_2 &\leq 10 \\ 6X_1 + 6X_2 &\leq 36 \\ X_1 &\leq 6 \\ \text{and } X_1, X_2 &\geq 0. \end{aligned}$$

- 3 (a) A dairy firm has three plants located in a state. The daily milk production at each plant is as follows:  
Plant 1 : 6 million litres,  
Plant 2 : 1 million litres, and  
Plant 3 : 10 million litres.

Each day, the firm must fulfill the needs of its four distribution centres. The minimum requirement of each centre is as follows:

Distribution centre 1 : 7 million litres,      Distribution centre 2 : 5 million litres,  
Distribution centre 3 : 3 million litres,      Distribution centre 4 : 2 million litres,

Cost (in hundred rupees) of shipping one million litres from each plant to each distribution centre is given in the following table:

		Distribution centre			
		D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>
Plant	P <sub>1</sub>	2	3	11	7
	P <sub>2</sub>	1	0	6	1
	P <sub>3</sub>	5	8	15	9

Find the initial basic feasible solution for given problem.

- (b) A computer centre has three expert programmers. The centre wants three applications programmes to be developed. The head of the computer centre, after carefully studying the programmes to be developed, estimated the computer time in minutes required by the expert for the application programmes as follows:

		Programmers		
		A	B	C
Programmes	1	120	100	80
	2	80	90	110
	3	110	140	120

Assign the programmers to the programmes in such a way that the total computer time is minimum.

- 4 A manufacture wants to ship 22 loads of his product as shown below. The matrix gives the kilometer from sources to supply to the destination:

	Destination					supply
	$D_1$	$D_2$	$D_3$	$D_4$	$D_5$	
Source $S_1$	5	8	6	6	3	8
$S_2$	4	7	7	6	5	5
$S_3$	8	4	6	6	4	9
Demand	4	4	5	4	8	

The shipping cost is Rs 10 per load per Km. What shipping schedule should be used in order to minimize the total transportation cost.

- 5 (a) Enumerate assumption in game theory.  
 (b) A company management and the labour union are negotiating a new three years settlement. Each of these has 4 strategies:  
 (i) Hard and aggressive bargaining. (ii) Reasoning and logical approach.  
 (iii) Legalistic strategy. (iv) Conciliatory approach.

The cost to the company are given for each pair of strategy choice.

Union strategies	Company strategies			
	A	B	C	D
A	20	15	12	35
B	25	14	08	10
C	40	02	10	05
D	-5	04	11	0

What strategies will the two sides adopt? Also determine the value of the game.

- 6 (a) A book binder has one printing press, one binding machine, and manuscripts of a number of books. The time required to perform the printing and binding operation on each book are shown below. The binder wishes to determine the order in which the books should be processed, so that the total time required to process all books is minimized:

Books :	1	2	3	4	5	6
Printing time (Hours) :	30	120	50	20	90	110
Binding time (Hours) :	80	100	90	60	30	10

- (b) Five jobs are performed, first on machine X and then machine Y. The time taken, in hours by each job on each machine is given below:

Job :	A	B	C	D	E
Time on machine (x) :	12	04	20	14	22
Time on machine (y) :	06	14	16	18	10

Determine the optimum sequences of jobs that minimizes the total elapsed time to complete jobs. Also compute the minimum time.

- 7 (a) What do you understand by a Queue? Give some important applications of queuing theory.  
 (b) Consider a single server queuing system with poisson input and exponential service times. Suppose the mean arrival rate is 3 calling units per hour, the expected service time is 0.25 hours and the maximum permissible calling units in the system is two. Derive the steady state probability distribution of the number of calling units in the systems, and then calculate the expected number in the system.
- 8 (a) Explain the following in the context of project management:  
 (i) Activity variance and (ii) Project variance.  
 (b) Explain the following terms in PERT/CPM:  
 (i) Earliest time. (ii) Latest time. (iii) Total activity time. (iv) Even slack and (v) Critical path.

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