

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3700

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Unique Paper Code : 2413082009

Name of the Paper : Decision Science (Discipline Specific Elective (DSE)-
DSE-4.5)

Name of the Course : **B.Com. (Hons.) (UCGF)**

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are five questions in total.
3. Attempt all questions.
4. Parts of the question have to be attempted together.
5. All questions have equal marks.
6. Use of Simple Calculator is allowed.

1. A Manufacturing company makes three products, A, B and C, each of which requires three operations as a part of the manufacturing process. The company can sell all of the products it can manufacture but its production capability is limited by the capacity of its operation centres. (18)

P.T.O.

Additional data concerning the company are as follows:

Product	Manufacturing Requirements (hours/unit)			Cost (Rs.)	Selling Price (Rs.)
	Centre I	Centre II	Centre III		
A	1	3	2	11	15
B	3	4	1	12	20
C	2	2	2	10	16
Hours Available	160	120	180		

- (i) Formulate the above problem as LPP and find the optimal product mix by using simplex method.
- (ii) Write the dual of the above problem, read the optimal solution of the dual and give its economic interpretation.

OR

Given below is the simplex table for a maximization type of linear programming problem:

Cj	Basic Variable	15	12	11	0	0	0	Quantity
		X ₁	X ₂	X ₃	S ₁	S ₂	S ₃	
		0	1	8/13	4/13	-3/13	0	60/13
		1	0	11/13	-1/13	4/13	0	193/13
		0	0	-17/13	-15/13	8/13	1	87/13

Answer the following questions with reasons:

- (i) Complete the table and test whether solution is optimal or not? If not, find out the optimal solution.
- (ii) Is the solution feasible?
- (iii) Is it a case of multiple solutions? If so, show one such solution.
- (iv) Is the solution degenerate? If yes, which variable is degenerated?
- (v) Write the optimal product mix and the profit contribution of the above solution.
- (vi) If the company produces 13 units of X_3 , how many units of X_1 and X_2 shall have to be reduced, if any?
- (vii) What are the shadow prices of three resources?
- (viii) If the company wishes to expand the production capacity, which of the three departments should be given priority?
- (ix) If a customer is prepared to pay higher price for product X_3 , how much should the price be increased so that the company's profit remains unchanged?

(x) Write down the objective function of the above problem.

2. The following table summarizes the supply, demand, and cost information for the three factories (S_1, S_2, S_3) shipping goods to three warehouses (D_1, D_2, D_3).

Using the cost information given in the following table:

- (i) Find the initial basic feasible solution using the Vogel's Approximation Method.
- (ii) Find the optimal solution that minimizes the transportation cost (Use MODI method).

From \ To	D_1	D_2	D_3	Supply
S_1	9	8	5	25
S_2	6	8	4	35
S_3	7	6	9	40
Demand	30	25	45	100

OR

A company has five jobs to be done on five machines. Each job must be done on one and only one machine. The cost (in thousands of rupees) of each job on each machine is given in the following table:

Jobs	Machines				
	A	B	C	D	E
1	160	130	175	190	200
2	135	120	130	160	175
3	140	110	155	170	185
4	50	50	80	80	110
5	55	35	70	80	105

What are the job assignments which will minimize total cost? What is the total cost? (18)

3. (a) A Car park contains 5 cars. The arrival of cars is Poisson at a mean rate of 10 per hour.

The length of time each car spends in the car park is exponential distribution with a mean of 5 hours. How many cars are in the car park on an average? (6)

- (b) At what average rate must a clerk at a supermarket work in order to ensure a probability of 0.90 that the customer will not wait longer than 12 minutes? It is assumed that there is only one counter at which customer arrive in a Poisson fashion at an average rate of 15 per hour. The length of service by the clerk has an exponential distribution. (6)

(c) Solve the game whose payoff matrix is:

A	B				
		I	II	III	IV
	I	3	2	4	0
	II	2	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

(6)

OR

(d) Solve the following game whose payoff matrix is:

(9)

		B					
		I	II	III	IV	V	VI
A	I	4	2	0	2	1	1
	II	4	3	1	3	2	2
	III	4	3	7	-5	1	2
	IV	4	3	4	-1	2	2
	V	4	3	3	-2	2	2

- (e) There are 5 jobs each of which is to be processed on three machines A, B, and C in the order ACB. The time required to process in hours is given in the matrix below. Find the optimal sequence.

Job	1	2	3	4	5
Machine A	3	8	7	5	4
Machine B	7	9	5	6	10
Machine C	4	5	1	2	3

(9)

4. (a) A Company is considering purchasing a new machine, which will cost Rs. 10000/-. The economic life of the machine is expected to be 6 years. The salvage value of the machine will be Rs. 2000/-. The average operating and maintenance costs are estimated to be Rs. 5000/- per annum.

- (i) Assuming an interest rate of 10 %, determine the present value of future cost of the proposed machine.
- (ii) Compare this machine with the presently owned machine that has an annual operating cost of Rs. 4000/- per annum and expected maintenance cost of Rs. 2000/- in the second year with an annual increase of Rs. 1000/- thereafter. Should the new machine be purchased

(9)

- (b) A transport company has a single unloading berth with vehicles arriving in a Poisson fashion at an average rate of three per day. The unloading time distribution for a vehicle with n unloading workers is found to be exponentially with an average unloading time $(1/2) \times n$ days. The company has a large labour supply without regular working hours, and to avoid long waiting lines, the company has a policy of using as many unloading group of workers in a vehicle as there are vehicles waiting in line or being unloaded. Under these conditions, find:

(i) What will be the average number of unloading group of workers working at any time?

(ii) What is the probability that more than 4 groups of workers are needed?

(9)

OR

- (c) A manufacturer is offered 2 machines A and B. A is priced at Rs. 5000/- and running costs are estimated at Rs. 800/- for each of the first five years and increasing there by Rs. 200/- per year in the sixth and subsequent years. Machine B, which has the same capacity as A with Rs. 2500/- but will have running costs of Rs.1200 per year for 6 years, and increasing by Rs. 200/- per year thereafter. If money is worth 10 % per year, which machine should be purchased? Assume that the scrap value for both machines is negligible.

(9)

- (d) Arrival rate of telephone calls at a telephone booth is according to Poisson distribution, with an average time of 9 minutes between consecutive arrivals. The length of telephone call is exponentially distributed with a mean of 3 minutes. Find: (9)

- (i) Determine the probability that a person arriving at the booth will have to wait
- (ii) Find the average queue length that forms from time to time
- (iii) The telephone company will install a second booth when convinces that an arrival would expect to have to wait at least four minutes for the phone. Find the increase in flow of arrivals, which will justify a second booth
- (iv) What is the probability that an arrival will have to wait for more than 10 minutes before the phone is free?
- (v) What is the probability that they will have to wait for more than 10 minutes before the phone is available and the call is also complete?

(vi) Find the fraction of a day that the phone will be in use.

5. (a) What is PERT? How is it different from CPM? (3)

(b) Explain the steps in Critical Path Analysis? (6)

(c) A small project has 7 activities and the time in days for each activity is given below:

Activity	Duration in days
A	6
B	8
C	3
D	4
E	6
F	10
G	3

Given that activities A and B can start at the beginning of the project. When A is completed C and D can start. E can start only when B and D are finished. F can start when B, C and D are completed and is the final activity. G can start when E is finished and is the final activity.

Draw the network and find the project completion time. (9)

OR

(d) There are seven activities in a project and the time estimates are as follows:

Activities	Time in Weeks		
	T0	T1	TP
A	2	6	10
B	4	6	12
C	2	3	4
D	2	4	6
E	3	6	9
F	6	10	14
G	1	3	5

(i) The activities are sequenced as follows:

(ii) Activities A and B start at the beginning of the project.

(iii) When A is completed, C and D start.

(iv) E can start when B and D are finished.

(v) F can start when B, C and D are completed.

(vi) G can start when F is finished and is final activity

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What is the expected time of the duration of the project? What is the probability that project will be completed in 22 weeks? (15)

(e) Elaborate various phases of Project Management. (3)