

**IV B.Tech I Semester Supplementary Examinations, February 2007**  
**OPERATIONS RESEARCH**  
 ( Common to Mechanical Engineering, Mechatronics and Production Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
 All Questions carry equal marks

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1. (a) What are the general steps involved in solution of OR problem.  
 (b) What are the steps to solution of a LP problem by graphical method? [8+8]
2. (a) Distinguish between a transportation problem and an assignment problem.  
 (b) Solve the following transportation problem with transportation cost, demand and supplies as given below. [4+12]

Ware House

		W1	W2	W3	W4	Demand
Factory	F1	19	30	50	10	7
	F2	70	30	40	60	9
	F3	40	8	70	20	18
Supply		5	8	7	14	

3. (a) The owner of a small machine shop has four machinists available to assign to jobs for the day. Five jobs are offered with the expected profit (in hundreds of rupees) for each machinist on each job being as follows :

Machinist	A	B	C	D	E
1	6	8	5	10	8
2	7	9	6	7	6
3	9	9	11	7	8
4	5	6	9	8	8

Find the assignment of machinists to jobs that result in a maximum profit. Which job should be declined.

- (b) Find the sequence that minimizes total elapsed time required to complete the following jobs : [8+8]

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

4. (a) Briefly explain the reasons for replacement.  
 (b) The following table gives the running costs /year and resale price of equipment whose purchase price is Rs.8000.

Year	1	2	3	4	5	6	7	8
Running Cost(Rs.)	2500	2600	2800	3100	3500	3900	4400	5400
Resale Value(Rs.)	6500	5500	4700	4200	3800	3500	3500	3500

- i. At what year is replacement due?  
 ii. If the resale value is zero, will there be any change in the replacement policy? [4+12]
5. (a) Consider the following pay-off matrix and determine the optimal strategy.

B

	I	II	III	
A	I	6	9	4
	II	5	10	7
	III	9	8	9

- (b) Write a note on zero-sum games [12+4]
6. An artist in the Shilparamam has 8 persons for whom the artist performs painting works. Arrival rate is poisson stream and the service times are exponential. Average arrival rate is 5 per hour with an average service time of 20 minutes. Cost of waiting is Rs.120 per hour, while the cost of service Rs 75 each. Calculate
- (a) the average length of the waiting line  
 (b) the average waiting time of an arrival  
 (c) the average time which an arrival spends in the system and  
 (d) the minimum cost service rate. [16]
7. (a) Describe decision rules for a purchase inventory model with two price breaks without shortages.  
 (b) Find the optimum order quantity for the following price break inventory problem: [4+12]

Annual demand:	200 units
Inventory carrying cost:	25%
Ordering cost:	Rs 20 per order
<u>Quantity</u>	<u>Price/Unit</u>
$0 \leq Q < 50$	Rs 10
$50 \leq Q < 100$	Rs 9
$100 \leq Q$	Rs 8

8. The owner of a chain of four grocery stores has purchased six crates of fresh strawberries. The estimated probability of potential sales of the strawberries before spoilage differ among the four stores. The following table gives the estimated total expected profit at each store when it is allocated various number of crates four administrative reasons. The owner does not wish to split crates between stores.

However he is willing to distribute zero crates to any of his stores. Find the allocation of six crates to five stores as to maximize the expected profit. [16]

	1	2	3	4
0	0	0	0	0
1	4	2	6	2
2	6	4	8	3
3	7	6	8	4
4	7	8	8	4
5	7	9	8	4

*No. of crates*

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1. (a) What are the phases of OR and briefly explain them?  
 (b) Find the minimum value of  $Z=4X_1+2X_2$   
 Subject to constraints:  $X_1+2X_2 \geq 2$   
 $3X_1+X_2 \geq 3$   
 $4X_1+3X_2 \geq 6$  and  
 $X_1, X_2 \geq 0$   
 by graphical method. [4+12]
  
2. (a) Distinguish between a transportation problem and an assignment problem.  
 (b) Solve the following transportation problem with transportation cost, demand and supplies as given below. [4+12]

Ware House

		W1	W2	W3	W4	Demand
Factory	F1	19	30	50	10	7
	F2	70	30	40	60	9
	F3	40	8	70	20	18
Supply		5	8	7	14	

3. Solve the following sequence problem to minimize the total time elapsed such that the operations sequence  $M_1M_2$

Job	1	2	3	4
Machine $M_1$	14	13	10	9
Machine $M_2$	9	7	8	6

Also find the total elapsed time and idle times of each machine [16]

4. A series lamp circuit contains 10,000 bulbs. When any bulb fails, it is replaced. The cost of replacing a bulb individually is Re.1 only. If all the bulbs are replaced simultaneously, the cost per bulb would be Re.0.35. The percent of surviving, say  $s(t)$  at the end of the month 't' and  $p(t)$  probabilities of failure during the month are given below:

t	0	1	2	3	4	5	6
s(t)	100	97	90	70	30	15	0
p(t)	-	0.03	0.07	0.20	0.40	0.15	0.15

what is the optimal replacement? [16]

5. Solve the following game by algebraic method [16]

		B	
		1	2
A	1	-2	-4
	2	-1	3
	3	1	2

6. In a Computer Sales stall of an exhibition public visit to enquire details of their products range. The average time between two arrivals is 30 seconds and the arrivals are to be Poisson distribution. The average service time is 45 seconds. Determine the

- (a) Average queue length
- (b) Average length of non-empty queues
- (c) Average number of public in system including the person being attended
- (d) Mean waiting time of an arrival. [16]

7. (a) Why is inventory maintained? Discuss it and give classifications of inventory models.

- (b) Compute E.O.Q and variable costs for the item having annual demand of 5000 units, unit price of Rs 20 per item, ordering cost at Rs 16 per order, storage rate at 2% per annum, interest rate at 12% per annum, obsolescence rate at 6% per annum. [6+10]

8. Use Dynamic programming to solve

$$\text{Minimize } Z = y_1^2 + y_2^2 + y_3^2$$

$$\text{Subjected to } y_1 + y_2 + y_3 = 5; \quad y_1, y_2, y_3 \geq 0 \quad [16]$$

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1. (a) Show on a graph the following:

- i. Unbounded solution space.
- ii. No feasible solution space.

(b) Solve the following LPP graphically:

$$\text{Maximize } Z = 2x_1 + 3x_2$$

Subject to :

$$x_1 + x_2 \geq 1$$

$$5x_1 - x_2 \geq 0$$

$$x_1 + x_2 \leq 6$$

$$x_1 - 5x_2 \leq 0$$

$$x_2 - x_1 \geq -1$$

$$x_2 \leq 3$$

$$x_1, x_2 \geq 0$$

[4+12]

2. (a) Explain with example 'North West Corner Rule' .

(b) Transwell transportation company has agreed to transport the products from factory A and B to market places C,D and E. The unit transportation cost (in hundred of rupees), supply and demand are given in the table below.

Factory/Market	C	D	E	Supply
A	3	7	9	30
B	4	6	2	10
Demand	10	27	3	

What is the maximum profit for the transportation company from the trans-shipment of the products? [4+12]

3. (a) Give two areas for the application of assignment problem

(b) A company has five trucks available for use located in cities A, B, C, D and E. One truck is required in cities 1, 2, 3, 4, 5 and 6. The mileage between cities is shown in Table. Determine the assignment of trucks that will minimise the mileage travelled by all trucks [4+12]

From cities	To cities					
	1	2	3	4	5	6
A	20	15	26	40	32	12
B	15	32	46	26	28	20
C	18	15	2	12	6	14
D	8	24	12	22	22	20
E	12	20	18	10	22	15

4. (a) Briefly explain the reasons for replacement.  
 (b) The following table gives the running costs /year and resale price of equipment whose purchase price is Rs.8000.

Year	1	2	3	4	5	6	7	8
Running Cost(Rs.)	2500	2600	2800	3100	3500	3900	4400	5400
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- i. At what year is replacement due?  
 ii. If the resale value is zero, will there be any change in the replacement policy? [4+12]
5. (a) Briefly explain “dominance property”  
 (b) A and B play game in which each has three coins 5p,10p and a 20p. Each selects a coin without the knowledge of the others choice. If the sum of the coins is an odd amount, A wins B’s coin. If the sum is even B wins A’s coin. Find the best strategy for each player and the value of the game. [4+12]
6. (a) Explain the constituents of a single channel.  
 (b) People arrive at a theatre ticket booth in a Poisson distribution arrival rate of 50 per hour. Service time is constant at 90 seconds. Calculate  
 i. the mean number in the waiting line  
 ii. the mean waiting time  
 iii. the percent of time an arrival can walk right in without having to wait. [4+12]
7. A baking company sells cake by kg weight. It makes a profit of Rs.5 per kg on each kg sold on the day it is baked. It disposes of all cakes not sold on the day it is baked at a loss of Rs.1.20 a kg. If the demand is known to be rectangular between 2000 and 3000 kgs. Determine the optimal daily amount baked. [16]
8. (a) Write a note on the application of dynamic programming.  
 (b) Define the following terms in dynamic programming :  
 i. State  
 ii. State variable  
 iii. Immediate return  
 iv. Optimal return . [8+8]

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1. (a) What is a model? Briefly explain about iconic and analogue models.  
 (b) Use Big-M method to Minimize  $Z=12X_1+20X_2$   
 Subject to the constraints  
 $6X_1+8X_2 \geq 100$   
 $7X_1+12X_2 \geq 120$  and  
 $X_1, X_2 \geq 0$  [4+12]

2. Consider the following transportation problem and find an optimum solution  
 Demand points

	1	2	3	4	↓ Supply
1	2	3	11	7	6
Source 2	1	0	6	1	1
3	5	8	15	9	10
Demand →	7	5	3	2	17

[16]

3. (a) What is a travelling salesman problem?  
 (b) Solve the following travelling salesman problem [4+12]

		To			
		A	B	C	D
From	A	-	46	16	40
	B	41	-	50	40
	C	82	32	-	60
	D	40	40	36	-

4. A manufacturer is offered two 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, creasing by Rs.200per year in the sixth and subsequent years. Machine B, which has the same capacity as A, costs Rs.2500 but will have running costs of Rs.1200 per year for six years, increasing by Rs.2000 per year thereafter.If the money is worth 10% per year, which machine should be purchased assuming that both machines will eventually be sold for a scrap at a negligible value. [16]

5. (a) Briefly explain the general rules for dominance.  
 (b) Use dominance property to reduce the game to 2x2 game and hence find the optimal strategies [4+12]



		Player B			
		5	-10	9	0
Player A	6	7	8	1	
	8	7	15	1	
	3	4	-1	4	

6. For a M/M/1: ( $\alpha$ /FCFS) queuing model find the expected value of the number of units in the system and the probability that a unit arriving in system will have to wait. And also find the expected waiting time in the queue. [16]
7. (a) With the help of quantity-cost curve, explain the significance of economic order quantity. What are the limitations in using economic order quantity formula?
- (b) A purchase manager places order for an item in lot of 500 numbers of particular item. Inventory carrying costs are 40% of the units cost, which is Rs 50 per item, the ordering cost is Rs 600 per order, and the annual demand for the item is estimated at 1000 units. Find out the loss incurred by the company for not following the scientific inventory policy. [6+10]
8. (a) State Belman's principle of optimality and explain by an illustrative example, how it can be used to solve multi stage decision problem.
- (b) Define the following terms in dynamic programming :
- i. Stage
  - ii. Decision variable
  - iii. Optimal return
  - iv. State transformation function. [8+8]

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