

IV B.Tech II Semester Regular Examinations, Apr/May 2008
OPERATIONS RESEARCH
 (Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. (a) Explain the similarities and differences between Transportation model and Resource Allocation model. [6]
- (b) What do you mean by degeneracy in a Linear Programming Problem? [5]
- (c) What do you mean by a tie in linear programming problem? [5]

2. Write the dual of the below given problem:

$$\text{Maximize } Z = 2x + 5z$$

ST

$$1x + 1y \geq 2$$

$$2x + 1y + 6z \leq 6$$

$$1x - 1y + 3z = 4 \text{ and } x, y \text{ and } z \text{ all } \geq 0$$

Solve the dual for optimal solution.

Give the solution of Primal problem.

[16]

3. (a) Explain time minimization transportation problem.
- (b) Solve the following minimization transportation problem. [4+12]

		Destination					Availability
		D_1	D_2	D_3	D_4	D_5	
Origin	O_1	5	1	3	4	4	60
	O_2	2	3	2	2	3	25
	O_3	3	6	2	4	5	50
Requirement		25	40	18	20	32	

4. (a) Explain how the theory of replacement is used in the following cases.
 - i. Replacement of items whose maintenance cost varies with time ignoring changes in the money value and
 - ii. without ignoring changes in the money value. [3+3]
- (b) A scooter has been purchased at Rs.21,500 /- initially . The resale value and maintenance cost against the year is given below. [10]

Year	1	2	3	4	5
Maintenance cost in Rs.	900	1500	2000	2700	4000
Resale value in Rs.	16,000	15,200	13,300	12,100	10,500

At what age is replacement due?

5. (a) List the characteristics of competitive games. [4]
 (b) Two companies A and B are competing for the same product. Their different strategies are given in the following pay off matrix. [12]

		Company A		
		A1	A2	A3
Company B	B1	2	-2	3
	B2	-3	5	-1

What are the best strategies for both the companies? Find out the value of the Game.

6. Mr. X is a student. He does odd jobs to supplement his income. Job requests come every five days on the average but the time between the requests is exponential. The time for completing a job is also exponential with mean 4 days.
- (a) What is the probability that Mr. X will be out of jobs
 (b) If Mr. X gets about Rs. 50/- a job what is his average monthly income
 (c) If at the end of the semester Mr. X decides to subcontract on the outstanding jobs at Rs. 40/- each, how much on the average should he expect to pay. [16]
7. (a) Derive an expression for E.O.Q for an inventory model with uniform demand and Instantaneous replenishment with no short ages.
 (b) Explain why inventory control is important in an industry. Mention its advantages & disadvantages. [8+8]
8. Seven units of capital can be invested in four activities with the return from each activity given in the accompanying table. Find the allocation of capital to each activity that will maximize the total return. What will be the total return if the available capital is reduced by one unit? [16]

Q	$g^1(H)$	$g^2(H)$	$g^3(H)$	$g^4(H)$
0	0	0	0	0
1	1	3	2	1
2	4	5	3	3
3	6	7	4	5
4	7	9	5	6
5	8	10	5	7
6	9	11	5	8
7	9	12	5	8

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1. Discuss the advantages and disadvantages or limitations of using results from a mathematical model to make decisions about operations. [16]

2. Maximize using Simplex Method.

$$Z = 10x + 1y + 2z$$

ST

$$1x + 1y - 2z \leq 10$$

$$4x + 1y + 1z \leq 20$$

$$\text{and } x, y \text{ and } z \text{ all } \geq 0$$

[16]

3. A book binder has one printing press, one binding machine, and the manuscripts of a number of different books. The cost of the printing and binding operations for each book are known. Determine the order in which books should be processed, in order to minimize the total production cost. [16]

Book	Printing cost (Rs.)	Binding cost (Rs.)
1	550	45
2	1400	120
3	800	75
4	350	45
5	1250	100
6	600	50

4. A machine costs Rs.12000 when new. The running costs are Rs.1920/- for the first 5 years, increasing by Rs.480/- per year thereafter. Assuming a 10% discount rate of money per year. Find the optimum length of time to hold the machine before we replace it. [16]

5. Find the game value for the given problem. [16]

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

6. People arrive at a theater ticket booth in a Poisson distributed arrival rate of 25 per hour. Service time is constant at 2 minutes. Calculate

- (a) The number in waiting line.
(b) The mean waiting time.
(c) The percent of time an arrival can walk right in without having to wait. [16]
7. (a) A company producing 3 items has a limited storage space of averagely 750 items of all types. Determine the optimal production quantities for each item separately when the following information is given [10]

Product	1	2	3
Holding Cost (Rs.)	0.05	0.02	0.04
Set up Cost (Rs.)	50	40	60
Demand rate (per unit)	100	120	75

- (b) What is quantity discounts? Explain briefly? [6]
8. (a) Briefly discuss the applications of dynamic programming. [4]
(b) Solve the following problem by using dynamic programming. [12]
Max. $Z = x_1 + 9x_2$
Subject to : $2x_1 + x_2 \leq 25, x_2 \leq 11, x_1x_2 \geq 0$

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1. (a) Operations Research is simply Research into Operations – Explain.
 (b) What are the properties of a Linear-programming Problem? - Explain. [8+8]
2. Maximize using Simplex Method.
 $Z = 10x + 1y + 2z$
 ST
 $1x + 1y - 2z \leq 10$
 $4x + 1y + 1z \leq 20$
 and x, y and z all ≥ 0 [16]
3. Solve the following travelling salesman problem: [16]

From/To	1	2	3	4	5	6
1	∞	8	5	9	7	6
2	8	∞	9	6	4	5
3	5	9	∞	10	3	12
4	9	6	10	∞	8	7
5	7	4	3	8	∞	4
6	6	5	12	7	4	∞

4. The following failure rates have been observed for a certain type of light bulbs:

End of week :	1	2	3	4	5	6	7	8
Probability of failure to date :	0.05	0.13	0.25	0.43	0.68	0.88	0.96	1.00

The total no. of bulbs are 1000. The cost of replacing an individual bulb is Rs 1.25. The decision is made to replace all bulbs simultaneously at fixed intervals and also to replace individual bulbs as they fail in service. If the cost of group replacement is 30 paise per bulb. What is the best interval between group replacements? [16]

5. (a) Explain the following:
 - i. competitive games
 - ii. Two-person zero-sum game [3+3]
- (b) Solve the following game [10]

		Player A		
		A1	A2	A3
Player B	B1	-6	10	11
	B2	-1	-2	-3

6. Self-service at a university cafeteria at an average rate of 7 minutes per customer, is slower than attendant service, which has a rate of 6 minutes per student. The manager of the cafeteria wishes to calculate the average number of customers in the cafeteria, the average time each customer spends and the average time each student spends waiting for service. Assume that customers arrive randomly at each time, at the rate of 5 per hour. Calculate the appropriate operating statistics for this cafeteria. [16]
7. (a) A company would like to improve its inventory policy for its supply of paint used for automobiles. The annual demand for such paint 50,000 litres and the paint costs Rs 20/litre and is used at a constant rate. Annual carrying cost are estimated at 15% of the value of the paint held. Each order cost Rs 80. Determine
- i. How much paint should be ordered each time.
 - ii. How often it should be ordered.
 - iii. Time between two consecutive orders. [12]
- (b) What functions does inventory perform? [4]
8. (a) Briefly discuss the applications of dynamic programming. [4]
- (b) Solve the following problem by using dynamic programming. [12]
- Max. $Z = x_1 + 9x_2$
Subject to : $2x_1 + x_2 \leq 25, x_2 \leq 11, x_1x_2 \geq 0$

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1. Explain the general nature of optimization problems and discuss their significance in relations to Operations Research problems. Do all Operations Research problems involve Optimization? Explain. [16]
2. A firm manufactures two products A and B. It can sell an unlimited amount of each product and wishes to determine the optimal product mix for maximizing the profit. The required information is as follows:
 Resources: Raw material X = 1600 Kg; Y = 750 Kg.
 Equipment time = 60 hours, Labour time = 150 hours.

Bill of Materials:

Item.	Product A	Product B
Material X	2 Kg.	—
Material Y	0.5 Kg.	0.5 Kg.
Equipment time:	0.06 Hrs.	0.04 Hrs.
Labour time	0.10 Hr.	0.15 Hr.

Cost and Price information:

Item.	Product A	Product B
Selling Price.	Rs.6/-	Rs.5/-
Cost of Material X:	Re. 1/	—
Cost of material Y:	Re.0.50	Re. 0.50
Equipment cost	Rs. 3/-	Rs. 2/-
Labour Cost.	Re. 0.40	Re. 0.60
Formulate the L.P.Model and solve by Simplex method.		[16]

3. (a) Explain necessary condition for solving n Jobs and 3 machines.
- (b) A book binder has one printing press, one binding machine, and the manuscripts of a number of different books. The time required to perform the printing and binding operations for each book are known. Determine the order in which books should be processed on the machines, in order to minimize the total time required. [6+10]

Book	Printing time	Binding time
1	20	60
2	120	100
3	50	90
4	30	80
5	90	30
6	110	10

4. A machine costs Rs.6000 when new. The running cost and salvage value at the end of year is given. The running costs are assumed to have occurred at the middle of the each year. With this assumption, determine when the machine is to be replaced with the interest rate is 10% . [16]

Year	1	2	3	4	5	6	7
Running cost in Rs.	1200	1500	1700	1800	2100	2500	3100
Resale value in Rs.	4100	2775	2100	1600	1050	600	600

5. (a) List the characteristics of competitive games. [4]
 (b) Two companies A and B are competing for the same product. Their different strategies are given in the following pay off matrix. [12]

		Company A		
		A1	A2	A3
Company B	B1	2	-2	3
	B2	-3	5	-1

What are the best strategies for both the companies? Find out the value of the Game.

6. Demand for an item occurs accordingly to P.D. with mean 3 per day the maximum stock level is 25 items, which occurs in each Monday immediately after a new order is received the order size depends on the number of units left at the end of the week on Saturday (business closed on Sunday) determine
- Average weekly size of the order.
 - Probability of incurring the shortage when the business opens on Friday morning.
 - The probability that weekly order size exceeds 10 units. [16]
7. A shopkeeper has a uniform demand of an item at the rate of 50 items / month. He buys from a supplier at a cost of Rs. 6 per item and the cost of ordering is Rs. 10 /- each time . If the stock holding costs are 20 % / year of stock value. How frequently should he replenish his stocks. Now suppose the supplies offers 5 % discount on orders between 200 and 999 items and a 10 % discount on orders exceeding or equal to 1000 can the shop keeper reduce his costs by taking advantage of either of these discounts. [16]

8. (a) Explain the concept of dynamic programming. [4]

(b) Solve the following linear programming problem by using dynamic programming technique [12]

$$\text{Max } z = 50x_1 + 100x_2$$

Subject to the constraints :

$$10x_1 + 5x_2 \leq 2500$$

$$4x_1 + 10x_2 \leq 2000$$

$$x_1 + 3/2x_2 \leq 450$$

$$x_1, x_2 \geq 0.$$
