

IV B.Tech. I Semester Regular Examinations, November -2005
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

1. (a) What is Operations Research? What are the phases of OR?
 (b) Solve the following LPP by using Simplex method.
 Minimize $Z = X_1 - 3X_2 + 2X_3$
 Subject to
 $3X_1 - X_2 + 3X_3 \leq 7$
 $-2X_1 + 4X_2 \leq 12$
 $-4X_1 + 3X_2 + 8X_3 \leq 10$ and $X_1, X_2, X_3 \geq 0$ [4+12]

2. X transport Company has four warehouses A,B,C and D. It is required to deliver a product from these warehouses to three customers P,Q and R. The warehouses have the following amounts in stock :

Warehouse :	A	B	C	D
Number of Units :	15	16	12	13

And the customers requirements are :

Customer :	P	Q	R
Number of Units :	18	20	18

The table below shows the costs (in hundreds of rupees) of transporting one unit from warehouse to the customer. Solve the problem to minimize the transportation cost. [16]

	A	B	C	D
P	8	9	6	3
Q	6	11	5	10
R	3	8	7	9

3. (a) What are the conditions to be satisfied to convert a 'n' jobs 3 machine problem in to 'n' jobs 2 machines problem?
 (b) There are five jobs and three operations are required for each of the jobs. Determine the order in which the jobs are to be processed in order to minimise the total time required to process all the jobs. Find the total time required to process all jobs and the idle time of each machine [6+10]

Job	Shearing time	Punching time	Deburring time
1	40	50	80
2	20	60	100
3	80	20	60
4	50	30	70
5	60	40	110

4. A decision has to be made for group replacement versus individual replacement policy for 500 fluorescent tubes of a particular make in the university campus. Failure rate for the tubes were recorded as under:

End of month	1	2	3	4	5	6
Prob. Of failure	0.11	0.30	0.25	0.20	0.10	0.04

Cost of replacing an individual tube is Rs.55 and when replaced as group it is Rs.35. Find out whether group replacement policy is economical or not. If economical at the end of which month should the tubes be replaced as a group? [16]

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. (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
- the mean number in the waiting line
 - the mean waiting time
 - the percent of time an arrival can walk right in without having to wait.
- [4+12]
7. (a) In a certain manufacturing situation, the production is instantaneous and the demand per day is R. Derive the formula to optimal order quantity Q per run which minimizes the total cost if C1 is the cost of holding one unit of inventory per day, C2 is the unit cost of shortage per day and C3 is the set up cost per run.
- (b) The demand of an item is uniform at a rate of 35 units per month. The fixed cost is Rs. 25/- each time a production run is made. The production cost is Rs.1 per item, and the inventory carrying cost is 50 paise per item per month. If the shortage cost is Rs. 1.5 per item per month, determine how often to make a production run and of what size it should be? [8+8]
8. An item have five months selling period with the probability distribution (given below) of selling in each month.

	Probability distribution of selling price ineach month				
Price	1	2	3	4	5
4	0.1	0.05	0.05	0.05	0.05
5	0.1	0.1	0.15	0.05	0.25
6	0.2	0.15	0.3	0.35	0.30
7	0.3	0.25	0.15	0.25	0.20
8	0.15	0.20	0.15	0.15	0.15
9	0.10	0.15	0.10	0.10	0.02
10	0.05	0.10	0.10	0.05	0.00

- (a) Calculate the expected price for each.
- (b) Faced with these probability distribution for the price over the demand season use a method of dynamic programming to determine an optimal selling policy.

[16]

IV B.Tech. I Semester Regular Examinations, November -2005
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

1. Use Simplex method to solve the following LP problem.
 Minimise $Z = 3x + 2.5y$ subject to the following constraints
 $2x + 4y \geq 40$
 $5x + 2y \geq 50$ and $x, y \geq 0$ [16]

2. Solve the following transportation problem. [16]

	To			Supply
From	4	5	7	25
	7	7	3	20
	7	3	5	40
Demand	20	25	20	

3. Find the following sequencing problem to minimize the time elapsed with sequence $M_1 M_2$

Job	1	2	3	4	5
Maachine M_1	7	10	8	9	7
Maachine M_2	2	1	4	0	5

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

4. (a) The cost of a new machine is Rs.5000. The maintenance cost of nth year is given by $R_n = 500(n-1)$; $n=1,2,\dots$. Assuming that the money value will not change with time, after how many years will it be economical to replace the machine by new one?
- (b) A pipeline is due for repairs. It will cost Rs.10,000 and last for 3 years. Alternatively, a new pipeline can be laid at a cost of Rs.30,000 and lasts for 10 years. Assuming cost of capital to be 10% and ignoring salvage value, which alternative should be chosen? [8+8]
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. 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) What is inventory? Explain its importance in an industrial undertaking.
- (b) What are the different types of inventories in industries.
- (c) Describe various functions of inventory control. [8+3+5]
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]

★ ★ ★ ★ ★

IV B.Tech. I Semester Regular Examinations, November -2005
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

1. (a) Discuss the advantages and limitations of Linear Programming.
- (b) A firm manufactures three products A, B and C. Time to manufacture product A is twice that for B and thrice that for C and they are to be produced in the ratio 3:4:5. The relevant data is given in table. If the whole labour is engaged in manufacturing product A, 1600 units of this product can be produced. There is demand for atleast 300, 250 and 200 units of products A, B and C and the profit earned per unit is Rs. 50, Rs. 40 and Rs. 70 respectively. Formulate the problem as a linear programming problem [4+12]

Raw materials	Requirement per unit of Product (kg)			Total availability
	A	B	C	
P	6	5	9	5,000
Q	4	7	8	6,000

2. Solve the transportation problem. [16]

		Sales Station				
		I	II	III	IV	Production
Production plants	A	14	56	48	27	71
	B	82	35	21	81	47
	C	99	31	71	63	93
	Sales	71	35	45	60	211

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. The following mortality has been observed for a certain type of IC's used in a digital computer :

Week	1	2	3	4	5
Percent failing by the end of week	10	25	50	80	100

Group replacement of IC's costs Rs.0.30 per transistor, where as individual replacement costs Rs.1.25. What is the best interval between group replacements? At what group replacement price per transistor would a policy of strictly individual replacement become preferable to the adopted policy. [16]

5. (a) Briefly explain
- pure strategy
 - mixed strategy
 - optimal strategy
- (b) Find the saddle point, optimum strategies and value of the game in the following pay off matrix [6+10]

		Y			
		A	B	C	D
X	I	-3	4	2	9
	II	7	8	6	10
	III	6	2	4	-1

6. An airline has one reservation clerk on duty at a time. The clerk handles information about flight schedules and makes reservations. All calls to the airline are answered by an operator. If a caller requested information or reservation, the operator transfers the call of the person who has been waiting for the longest. Assume that arrivals and services follow Poisson and exponential distributions respectively. Calls arrive at a rate of 15 per hour and the reservation clerk can service a call in five minutes on the average.
- What is the average number of calls waiting to be connected to the reservation clerk ?
 - What is the average time a caller must wait before reaching the reservation clerk.
 - What is the average time for a caller to complete a call. [16]
7. (a) Derive the optimal economic lot size per run with minimum total cost if R is annual demand, Co is ordering cost per order, Ch is holding cost / unit/ year, and K is production rate where ($K > R$).
- (b) A contractor has to supply 10,000 bearings per day to an automobile manufacturer. He finds that when he starts a production run, he can produce 20,000 bearings per day. The cost of holding a bearing in stock for one year is 30 paise and setup cost of production run is Rs. 280/- how frequently, should production run be made. [8+8]
8. State Bellman's principle of optimality and explain by an illustrative example how it can be used to solve multistage problem with finite number of stages. [16]

IV B.Tech. I Semester Regular Examinations, November -2005
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

1. Solve the following LPP by simplex method

$$\text{Minimize } Z = 7x_1 + 2x_2$$

Subject to :

$$3x_1 + 5x_2 \geq 15$$

$$-x_1 + 3x_2 \leq 15$$

$$3x_1 + 2x_2 \leq 12$$

$$x_1, x_2 \geq 0$$

[16]

2. Solve the transportation problem.

[16]

		Sales Station				
		I	II	III	IV	Production
Production plants	A	14	56	48	27	71
	B	82	35	21	81	47
	C	99	31	71	63	93
Sales		71	35	45	60	211

3. Solve the following sequencing problem to minimizing the total time elapsed such that the operations sequence is M_1M_2 .

Job	1	2	3	4
Machine M_1	8	9	6	7
Machine M_2	15	20	16	16

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

[16]

4. (a) Explain briefly “how the replacement problems are classified”?
- (b) Fleet of cars have increased their costs as they continue in service due to increased direct operating cost (gas and oil) and increased maintenance (repairs, tyres, batteries, etc.). The initial cost is Rs.3,50,000 and the trade in value drop as time passes until it reaches a constant value of Rs.40,000. Given the cost of operating, maintaining and the trade in value, determine the proper length of service before cars should be replaced.

[4+12]

Years of service	1	2	3	4	5
Year end trade in value(Rs.)	2,90,000	2,10,000	1,50,000	1,10,000	40,000
Annual operating cost (Rs.)	11,500	12,800	13,600	14,000	15,000
Annual maintaining	3000	5000	8000	12,000	15,000

5. Solve the following game by algebraic method

[16]

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

6. Explain the following

- (a) Poisson's Process
- (b) Distribution of arrivals
- (c) Steady, transient and explosive states in queue system
- (d) Balking, Reneging and Jockeying.

[4+4+4+4]

7. (a) What is safety stock? Why are safety stocks necessary?

- (b) A company uses annually 48,000 units of raw material costing Rs. 1.25 per unit. Placing order costs Rs. 45 and carrying cost is 15% of average inventory. Find the EOQ. Suppose the company follows EOQ policy and it operates for 300 days in a year. The procurement time is 12 days with a safety stock of 500 units. Find the reorder point, the maximum, minimum and the average inventory.

[8+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 for 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]

<i>No. of crates</i>		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
