

III B.Tech. I Semester Supplementary Examinations, May -2005
OPERATIONS RESEARCH
(Electronics & Control Engineering)

Time: 3 hours**Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

1. Solve the following L.P.P. by considering its dual

$$\text{Maximize } Z = 45x_1 + 80x_2$$

Subject to the Constraints

$$5x_1 + 20x_2 \leq 400$$

$$10x_1 + 15x_2 \leq 450$$

$$x_1, x_2 \geq 0$$

2. Solve the following transportation problem, the matrix represents the times t_{ij} :

		To				
		P	Q	R	S	Availability
From	A	6	7	3	7	5
	B	7	9	1	5	7
	C	6	5	16	7	8
	D	18	9	10	2	10
Demand:		10	5	10	5	

3. (a) A salesman has to visit five cities A,B,C,D and E. The distances (in hundred Kms) between the given cities are as follows

From/To	A	B	C	D	E
A	-	7	6	8	4
B	7	-	8	5	6
C	6	8	-	9	7
D	8	5	9	-	8
E	4	6	7	8	-

If the salesman starts from city A and has to come back to city A, which route should the salesman select so that the total distance traveled is minimum.

- (b) A Company has six jobs which go through three machines ABC in the order CBA the processing time in minutes for each job on each machine is as follows :

Job	1	2	3	4
Machine A	23	28	12	19
Machine B	11	6	12	7
Machine C	29	43	12	18

4. A machine has initial investment of Rs.30,000 and its salvage value at the end of 'i' years of its use is estimated as $\text{Rs.}30,000/(i+1)$. The annual operating and maintenance cost in the first year is Rs.15,000 and increases by Rs.1000 in each subsequent years for the first five years and increases by Rs.5000 in each year

thereafter. Replacement policy is to be planned over a period of seven years. During this period cost of capital may be taken as 10% per year. Solve the problem for optimal replacement.

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

6. A car park has space to accommodate 40 cars. The arrival of cars is Poisson at a mean rate of 2 per minutes. The length of time each car spends in the car park has negative exponential distribution with mean of 30 minutes?

- (a) How many cars are in the car park on average ?
 (b) what is probability of a newly arriving customer finding the car park full ?
 (c) what is the probability of having zero cars in the car park space ?

7. (a) What are advantages and disadvantages of classifying inventory into A B C?

- (b) Find the economic order quantity for the data given below:

Annual demand:	2400 units
Unit cost of the item:	Rs 2 per unit
Ordering cost:	Rs 30 per order
Inventory holding cost:	20% of the unit cost

8. (a) What kind of problems can be solved by dynamic programming?

- (b) A sub contractor to Automobile industry has committed to supply at the end of each month during January to June a casting PE1806. The number of units to be supplied fluctuate from month to month as given below:

January	February	March	April	May	June
10	25	10	25	30	15

Batches of the casting are manufactured at a set up cost of Rs.300 for each. The inventory carrying cost is estimated at Rs.15 per unit per month. Schedules for production during a month are ready at the beginning of the month and a batch schedule for production will be completed by the end of the month. Castings produced over and above the requirement during a particular month can be stocked. However, there should not be any stock at the end of June when the contract terminates. Determine the optimal number of units to be manufactured each month using dynamic programming.

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1. (a) Briefly discuss the following:

- i. Iconic models
- ii. Analogue models

- (b) Solve the following LP Problem.

$$\text{Maximize } Z = 5X_1 + 2X_2$$

Subject to

$$2X_1 + 7X_2 \leq 100$$

$$3X_1 + 8X_2 \leq 135$$

$$\text{and } X_1, X_2 \geq 0$$

2. Solve the Transportation problem. The matrix shows the cost of Transportation.

From	To			Supply
	1	2	3	
A	10	18	9	100
B	4	3	11	200
C	6	9	15	400
Demand	250	150	300	700

3. Find the minimum cost solution for the 5 x 5 assignment problem whose cost coefficients are as given below.

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

4. (a) Explain briefly the importance of Replacement Analysis.
- (b) What do you mean by “Money value is not counted and counted” in Replacement Analysis.
- (c) The cost of the machine is Rs.6100 and its scrap value is only Rs.100. The maintenance costs are found to be:

Year	1	2	3	4	5	6	7	8
Maintenance	100	250	400	600	900	1250	1600	2000

when should the machine be replaced?

5. Solve the following 2x3 game by method of sub-games

		B		
		1	2	3
A	1	-1	7	6
	2	5	-3	3

6. (a) Write some important applications of queuing theory.
- (b) A P.C. repairperson finds that the time spent on jobs has an exponential distribution with mean 30 minutes. If the sets are repaired in the order in which they come in, and if the arrival of sets is approximately poisson with an average of 10 per 8 hour day, what is the repairperson's expected idle time each day ? How many jobs are ahead of the average set just brought in ?
7. (a) Write a short notes on Inventory models with price breaks.
- (b) A company uses annual 24,000 units of Raw material which costs Rs. 1.25 per unit. Placing each order costs Rs. 22.5 and the carrying cost is 5.4% per year of the average inventory. Find the Economic Order Quantity and the total inventory cost. Should the company accept the offer made by the supplier of a discount of 5% on the cost price on a single order of 24000 units.
8. An electronic item has three components in series. The reliability of the system is equal to the product of the reliabilities of the three components, i.e. $R = r_1 r_2 r_3$. It is a known fact that the reliability of the system can be improved by providing standby units at extra cost. The details of costs and reliabilities for different number of standby units for each of the components of the system are summarized in table.

N.of Standby units	Component 1		Component 2		Component 3	
	Cost (Rs)	Reliability	Cost (Rs)	Reliability	Cost (Rs)	Reliability
1	1	0.75	3	0.84	2	0.80
2	2	0.88	4	0.94	3	0.91
3	4	0.94	6	0.97	5	0.96

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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 $X_1, X_2, X_3 \geq 0$
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.

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) Write short notes on sequencing decision problem for n jobs on two machines.
 (b) Alpha corporation has four plants each of which can manufacture any of the four products. Production costs differ from plant to plant as do sales revenue. From the following data, obtain which product each plant should produce to maximize profit :

Sales Revenue (Rs.'000 s)					Production Costs (Rs.'000 s)				
Plant	Production				Plant	Production			
	1	2	3	4		1	2	3	4
A	50	68	49	62	A	49	60	45	61
B	60	70	51	74	B	55	63	45	69
C	55	67	53	70	C	52	62	49	68
D	58	65	54	69	D	55	64	48	66

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?

5. (a) For the following pay-off matrix, determine the best strategies and the value of the game

		Y		
		j	k	l
X	p	60	50	40
	q	70	70	40
	r	80	60	75

- (b) Briefly explain the limitations of game theory.
6. Two repairpersons are attending five machines in a workshop. Each machine breaks down according to a Poisson distribution with mean three per hour. The repair time per machine is exponential with mean 15 minutes
- (a) find the probability
- that the two repairpersons are idle
 - that one repairperson is idle
- (b) What is the expected number of idle machines not being serviced ?
7. (a) What is inventory management?. Briefly, explain the major decisions concerning inventory.
- (b) A motor manufacturing co. purchases 18,000 items of certain motor part for its annual requirements, ordering one-month usage at a time. Each spare costs Rs 20. the ordering cost per order is Rs 15 and carrying charges are 15% of the unit item cost per year. Make a more economical purchasing policy. What is the savings by the new purchasing policy?
8. (a) State and explain the principle of optimality in dynamic programming
- (b) Consider the equipment replacement problem over a period of n years. A new piece of equipment costs c dollars, and its resale value after t years in operation is $s(t) = 2(n-t)$ for $n > t$ and zero otherwise. The annual revenue is a function of age t and is given by $r(t) = n^2 - t^2$ for $n > t$ and zero otherwise.
- Formulate the problem as a DP model.
 - Find the optimal replacement policy given $c = \text{Rs. } 10,000$, $n = 5$ and the equipment is 2 years old.

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1. (a) Operations Research replaces management by personality discuss.
 (b) State the general rules for converting a primal problem into its dual.
2. KEO Technocrat is manufacturing Disk Antennas and the company has two factories and three distribution centres in three cities. The supply and demand conditions for units of Disk Antennas are given below. How should the trips be scheduled so that the cost of transportation is minimum .

Cities	:	Chennai	Mumbai	Kolkata
Requirements	:	50	50	150
Cost per unit from Plants X(inRs.)	:	5000	7000	2000
Y	:	4000	1000	16000
Capacity of plant X	:	150	Units of disk antennas	
Y	:	100	"	"

3. (a) What is an unbalanced assignment problem? Explain the various steps involved in solving it.
 (b) A company has 4 machines to do 3 jobs. Each job can be assigned to one and only machine .The cost of each job on each machine is given in the following table.

		Machines			
		1	2	3	4
Jobs	A	18	24	28	32
	B	8	13	17	19
	C	10	15	19	22

What are job assignments which will minimise the cost?

4. A machine has initial investment of Rs.30,000 and its salvage value at the end of 'i' years of its use is estimated as $\text{Rs.}30,000/(i+1)$. The annual operating and maintenance cost in the first year is Rs.15,000 and increases by Rs.1000 in each subsequent years for the first five years and increases by Rs.5000 in each year thereafter. Replacement policy is to be planned over a period of seven years. During this period cost of capital may be taken as 10% per year. Solve the problem for optimal replacement.
5. (a) Explain briefly:
 - i. Competitive games
 - ii. zero-sum games
 - iii. strategy

- (b) Find the solution of the following game

		B		
		I	II	III
A	I	1	3	11
	II	8	5	2

6. (a) State some of the important distributions of arrival intervals and service times.
- (b) In a car gaurage A, if takes 15 minutes to wash one car. Cars arrive to the gaurage at an average rate of one every 25 minutes and arrival process is Poisson. In Car-gaurage B, it takes 25 minutes to wash one car and cars arrive to this shop at an average rate of one every 45 minutes, the arrival process being Poisson during steady state. Determine
- at which gaurage you expect the bigger queue.
 - at which gaurage you require more times waiting including the service time.
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.
8. (a) State and explain Richard E. Bellman principle of optimality in dynamic programming.
- (b) A manufacturing organization has the requirements of 100, 200, 300, 300 & 200 items for the ensuing five periods. The procurement cost is Rs.12 per procurement irrespective of the size of the purchase. The holding cost is Rs.2 per 100 items per period. The maximum inventory is not to exceed 400 items at any period. Formulate a dynamic programming problem and find the policy of procurement so as to minimize the total cost. No inventory is to be left in the last season. Maximum quantity ordered is 600.
