Code No: RR311303 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2006
OPERATIONS RESEARCH
(Electronics & Control Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Solve by simplex method.
   Minimize Z = 4x + y
   Subject to the constraints
   3x + 4y $\geq$ 20
   -x - 5y $\leq$ -15
   x, y $\geq$ 0 [16]

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 . [16]

Cities	Chennai	Mumbai	Kolkata
Requirements	50	50	150
Cost per unit form Plants X (in Rs)	5000	7000	2000
Y(in Rs)	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? [6+10]

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 operatiing cost (Rs.)	11,500	12,800	13,600	14,000	15,000
Annual maintaining	3000	5000	8000	12,000	15,000

5. (a) For the following pay-off matrix, find the optimal strategies and the value of the game.Use algebraic method.

		B		
		1	2	3
A	1	40	50	-70
	2	10	25	-10
	3	100	30	60

(b) Explain clearly optimal strategy and pure strategy [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) 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. Use Dynamic Programming to solve the Linear Programming Problem:
   Maximize Z= $x_1 + 9x_2$ subjected to $2x_1 + x_2 \leq 8$; $5x_1 + 2x_2 \leq 15$ where $x_1, x_2 \geq 0$. [16]

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

Answer any FIVE Questions
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1. (a) Show on a graph the following:
   i. Multiple optimum solution
   ii. Redundant constraint.
   (b) Solve the following LPP graphically:
   Maximize Z = 0.75 x_1 + x_2
   Subject to:
   $x_1 + x_2 \leq 5$
   $x_1 - x_2 \leq 0$
   $-0.5x_1 + x_2 \leq 1$
   $x_1 + 1.5\, x_2 \geq 3$
   $x_1, x_2 \geq 0$ [4+12]

2. Solve the following transportation problem [16]

		Products					
		1	2	3	4	5	Available capacity
	1	4	3	1	2	6	40
	2	5	2	3	4	5	30
Plants	3	3	5	6	3	2	20
	4	3	4	4	5	3	10
Potential Sales		30	30	15	20	5	100

3. (a) What is a sequencing problem?
   (b) Distinguish between "Sequencing" and "Scheduling"
   (c) A machine operator has to perform three operations turning, threading and knurling on different jobs. The time required to perform these operations (in minutes) for each job is known. Determine the order in which the jobs should be processed in order to minimise the total time required to work out all the jobs. Also find the minimum elapsed time. [2+4+10]

Jobs / Machine	1	2	3	4	5	6
I	3	12	5	2	9	11
II	8	6	4	6	3	1
III	13	14	9	12	8	13

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) 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. [10+6]

6. In a factory, the machine breakdown on an average rate is 10 machines per hour. The idle time cost of a machine is estimated to be Rs.150 per hour. The factory works 8 hours a day. The factory manager is considering 2 mechanics for repairing the machines. The first mechanic a takes, about 10 minutes on an average to repair a machine and demand wages Rs.100 per hour. The second mechanic B takes about 8 minutes in repairing a machine and demand wages at the rate of Rs.125 per hour. Assuming that the rate of machine breakdown is Poisson distributed and the repair rate is exponentially distributed, which of the two mechanics should be engaged ? [16]

7. (a) Formulate and solve the purchase inventory problem with one price break.

(b) Find the optimal order quantity for a product for which the price breaks are as follows.

Quantity	Unit cost(Rs.)
$0 \leq Q_1 < 500$	10.00
$500 \leq Q_2$	9.25

Monthly demand for a product is 200units.The cost of storage is 2% of the unit cost and the cost of ordering is Rs.350. [6+10]

8. (a) State Belmans 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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1. Solve the following LPP by simplex method.
   Minimise $Z = x_2 - 3x_3 + 2x5$
   Subject to Constraints:
   $x_1 + 3x_2 - x_3 + 2x5 = 7$
   $-2x_2 + 4x_3 + x_4 = 12$
   $-4x_2 + 3x_3 + 8x_5 + x_6 = 10$
   $xi \geq 0$, i = 1, 2, .6 [16]

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) Define total elapsed time and idle time on machines as referred to sequencing of Job in machines.
   (b) There are five jobs each of which must go through the machines A, B and C in the order ABC. The processing time (in hours) are as follows.

Jobs / Machines	1	2	3	4	5
A	4	3	8	6	5
B	5	6	2	3	4
C	8	10	6	7	11

   i. Determine the optimal sequence.
   ii. What will be the elapsed time?
   iii. What will be the idle time of the machines? [4+12

4. (a) Equipment A costs Rs.9000. Annual operating costs are Rs.200 for the first year and then increases by Rs.2,000 every year. Determine the best age at which to replace the equipment.

(b) Equipment B costs Rs.10,000.Annual operating costs are Rs.400 for the first year and then increases by Rs.800 every year. Now you have a equipment of type A which is one year old. Should you replace it with B,if so when? [8+8]

5. (a) Briefly explain the properties found in competitive games
   (b) Reduce the following game by dominance and find the game value: [4+12]

		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. A box-office ticket window is manned by single server. Customers arrive to purchase tickets according to a Poisson input process with a mean rate of 30 per hour. The time required to serve a customer has an exponential distribution with mean of 80 seconds. Determine the following :
   (a) Fraction of time the server is busy
   (b) The probability of having more than 12 customers in the system
   (c) The average number of customers queuing for more than 3 minutes. [16]

7. (a) Derive an expression for an economic lot size with different rates of demand in different cycles.
   (b) You are required to supply 100 units of certain product every Monday by obtaining the product from local supplier at Rs.60 per unit. The cost of ordering and transportation are Rs.150 per order the cost of carrying inventory is 15% per year of the cost of products carried . Describe graphically the inventory system. [8+8]

8. (a) What are the essential characterstics of Dynamic programming problems?
   (b) A manufacturing company has three sections producing automobile parts, computer parts and electronic gadget parts respectively. The management has allocated Rs 20,000 for expanding the production facilities. In the automobile parts in the computer parts section, The production can be increased either by adding new machine or by replacing some old inefficient machines by automatic machines. The electronic gadget parts section was started only a few days back and thus additional amount can be invested only by adding new machines to the section.
   The cost of adding and replacing the machines along with the association expected returns in the different sections is given in the table below. Select a set of expansion plans which may yield maximum return. Use dynamic

programming technique. [4+12]

Alternatives	Automobile parts		Computer parts		Electronic Gadgets	
	Cost(Rs)	Return(Rs)	Cost(Rs)	Return(Rs)	Cost(Rs)	Return(Rs)
1.No expansion	0	0	0	0	0	0
2.Add new machines	4000	8000	8000	12000	2000	8000
3.Replace old machines	6000	10000	12000	18000	-	-

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1. Solve the following LPP by simplex method.
   Maximize $Z = 2x_1 + x_2 + x_3$
   Subject to :
   $4x_1 + 6x_2 + 3x_3 \leq 8$
   $3x_1 - 6x_2 - 4x_3 \leq 1$
   $2x_1 + 3x_2 - 5x_3 \leq 4$
   x_1, x_2 and $x_3 \geq 0$ [16]

2. (a) Give the mathematical representation of a transportation problem.
   (b) For the following transportation problem find the solution for maximum profit.

		Ware House				
		W1	W2	W3	W4	Supply
Factory	F1	90	90	100	110	200
	F2	50	70	130	85	100
Demand		75	100	100	30	

   The cell values are profit per unit. [4+12]

3. (a) A project work consists of four major jobs for which four contractors have submitted tenders.The tender amounts quoted in lakhs of rupees are given in the matrix below:

Contractor/Job	a	b	c	d
1	10	24	30	15
2	16	22	28	12
3	12	20	32	10
4	9	26	34	16

   Find the assignment which minimizes the total cost of project.
   (b) A Company has jobs which must go through machines X,Y,Z in the order XYZ. The Processing times fare

Machine	Job			
	1	2	3	4
X	3	12	5	2
Y	8	10	9	6
Z	4	6	5	12

   What should be the sequence of jobs? [8+8]

4. (a) Equipment A costs Rs.9000. Annual operating costs are Rs.200 for the first year and then increases by Rs.2,000 every year. Determine the best age at which to replace the equipment.

(b) Equipment B costs Rs.10,000.Annual operating costs are Rs.400 for the first year and then increases by Rs.800 every year. Now you have a equipment of type A which is one year old. Should you replace it with B,if so when? [8+8]

5. Solve the following game by LPP [16]

		B		
		1	2	3
A	1	0	2	2
	2	3	-1	3
	3	4	4	-2

6. A self-service canteen employs one cashier at its canteen counter. The customers are to get their tokens for the dishes earlier. 10 customers arrive on an average every 7 minutes, while the cashier can serve 12 customers in 7 minutes. Assuming poisons distribution for arrival rate and exponential distribution for service, find
   (a) Average number of customers in the system
   (b) Average number of customers in waiting line or average length of the waiting line
   (c) Average time a customer spends in the system
   (d) Average time a customer waits before being served. [16]

7. (a) Derive an expression for EOQ with finite rate of replenishment with shortages.
   (b) An aircraft co. uses rivets at an approximate rate of 2500kg per year. Each unit costs Rs.30 per kg and the company personnel estimates that it costs Rs.130 to place an order and the carrying cost of inventory is 10% per year. How frequently should orders for rivets be placed? [8+8]

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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