Code No: 07A7EC03 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,MAY 2011
OPERATIONS RESEARCH
Common to Mechanical Engineering, Mechatronics, Automobile Engineering
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Discuss about simulation models and significance. [16]

2. In 18th century, when transportation systems were not developed, a family wanted to travel from their home to reach a friend's home in other part of the country. They had a choice of alternate routes and haltages between their home and the destination. The costs of travel from each point to the other point on route, based on such factors as distance, difficulty, mode of transportation, etc. are given below:

	1	2	3	4	5	6	7	8	9	10
1	–	7	5	4	–	–	–	–	–	–
2	–	–	–	–	8	3	9	–	–	–
3	–	–	–	–	10	7	6	–	–	–
4	–	–	–	–	4	5	6	–	–	–
5	–	–	–	–	–	–	–	6	8	–
6	–	–	–	–	–	–	–	7	4	–
7	–	–	–	–	–	–	–	3	6	–
8	–	–	–	–	–	–	–	–	–	5
9	–	–	–	–	–	–	–	–	–	4

Find the safest route so that the total traveling cost is minimum. [16]

3. A manufacturer has distribution located at Agra. Allahabad and Kolkata. These centers have available 40, 20 and 40 units of his product respectively His retail outlets at A, B, C, D and E require 25,10,20,30 and 15 units of the product, respectively. The shipping cost per unit (in rupees) between each center and outlet is given in the following table.

Distribution Centre	Retail Outlets				
	A	B	C	D	E
Agra	55	30	40	50	40
Allahabad	35	30	100	45	60
Kolkata	40	60	95	35	30

Determine the optimal shipping cost. [16]

4. (a) Discuss about a deterministic inventory model with shortages.

(b) A product 'X' is purchased by a company from outside suppliers. The consumption is 10,000 units per year. The cost of the item is Rs.5 per unit and the ordering cost is estimated to be Rs.100 per order. The cost of carrying inventory is 25%. If the consumption rate is uniform, determine the economic purchasing quantity. [6+10]

5. (a) What are the assumptions made in the theory of games?

(b) Obtain the optimal strategies for both players and the value of the game for two-person zero-sum game whose payoff matrix is given in table 5b. [6+10]

Player A	Player B	
	B_1	B_2
A_1	-6	7
A_2	4	-5
A_3	-1	-2
A_4	-2	5
A_5	7	-6

table 5b

6. (a) Give brief description of an LP problem with illustrations. How can it be solved graphically?

(b) Use the graphical method to solve the following LP Problem
Maximize $Z = 2x_1 + 3x_2$
subject to the constraints

$$x_1 + x_2 \leq 30$$
$$x_2 \geq 3$$
$$x_2 \leq 12$$
$$x_1 \leq 20$$
$$x_1 - x_2 \geq 0 \qquad x_1, x_2 \geq 0.$$

[6+10]

7. Problems arrive at a computer centre in a Poisson fashion at an average rate of 5/day. The rules of the computer centre are that any man waiting to get his problem solved must aid the man whose problem in being solved. If the time to solve a problem with one man has an exponential distribution with mean time of 1/3 day, and if the average solving time is inversely proportional to the number of people working on the problem, find the expected time for a person entering the line. [16]

8. (a) In the theory of replacement models, construct an equation for the cost of maintaining a system as a function of the control variable t (the number of periods between group replacement).

(b) It has been suggested by a data processing firm that they adopt a policy of periodically replacing all the 1000 tubes in a certain piece of equipment. A tube is known to have the mortality distribution (probability of failure) shown in the table below :

Tube failures/week :	1	2	3	4	5
Probability of failure :	0.3	0.1	0.1	0.2	0.3

The cost of replacing the tubes on an individual basis is estimated to be Re. 1.00 per tube and the cost of a group replacement is Re. 0.30 per tube. Compare the cost of preventive replacement with that of remedial replacement.

[6+10]

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Code No: 07A7EC03 **R07** **Set No. 4**

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1. (a) Give the mathematical formulation of an assignment problem.
   (b) Solve the assignment problem given in table 1b. The figures in the table represent the time required for each combination. [6+10]

Jobs \ Persons	1	2	3	4
I	12	30	21	15
II	18	33	9	31
III	44	25	24	21
IV	23	30	28	14

table 1b

2. (a) Explain the various applications of OR.
   (b) What are the advantages and limitations of OR? [8+8]

3. Solve the following LPP by dynamic programming:
   Maximize $Z = 50x_1 + 100x_2$, Subject to $2x_1 + 3x_2 \leq 48$,
   $x_1 + 3x_2 \leq 42$,
   $x_1 + x_2 \leq 21$,
   $x_1, x_2 \geq 0$. [16]

4. (a) Define the terms
      i. Lead time.
      ii. Reorder point.
      iii. Buffer stock.
   (b) A company uses 24,000 units of a raw material which costs Rs.12.50 per unit. Placing each order costs Rs.22.50 and the carrying cost is 5.4% per year of the average inventory. Find the economic order quantity and the total inventory cost (Including the cost of the material). [6+10]

5. A scooter cost Rs 6,000 when new. The running cost and salvage value at the end of different years are as follows: (in Rs):

Year :	1	2	3	4	5	6	7
Running cost :	1,200	1,400	1,600	1,800	2,000	2,000	2,400
values:	4,000	2,666	2,000	1,500	1,000	600	600

If the interest rate is 10 per cent per year and running costs are assumed to have occurred mid year, find when the scooter should be replaced. [16]

6. (a) Explain the difference between pure strategy and mixed strategy.
   (b) Obtain the strategies for both players and the value of the game for two-person zero-sum game whose payoff matrix is given in table 6b. [6+10]

Player A	Player B		
	B_1	B_2	B_3
A_1	1	3	11
A_2	8	5	2

table 6b

7. Workers come to tool store room to enquire about special tools (required by them) for accomplishing a particular project assigned to them. The average time between two arrivals is 60 seconds and the arrivals are assumed to be in Poisson distribution. The average service time (of the tool room attendant) is 40 seconds. Determine.
   (a) Average queue length.
   (b) Average length of non-empty queues.
   (c) Average number of workers in system including the worker being attended.
   (d) Mean waiting time of an arrival and
   (e) Average waiting time of an arrival who waits. [16]
8. What are the advantages of simulation? Explain Monte-Carlo simulation. [16]

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Code No: 07A7EC03 **R07** **Set No. 1**

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1. Solve the following LP Problem by two phase method
   Minimize Z = x_1 - $2x_2$ -$3x_3$
   subject to the constraints
   $$-2x_1 + x_2 + 3x_3 = 2$$
   $$2x_1 + 3x_2 + 4x_3 = 1$$
   $x_1, x_2, x_3 \geq 0$. [16]

2. (a) Explain North-West corner method for obtaining an initial basic feasible solution of a transportation problem.
   (b) Solve the transportation problem given in table 2b. [6+10]

	D_1	D_2	D_3	D_4	D_5	D_6	Available
O_1	2	1	3	3	2	5	50
O_2	3	2	2	4	3	4	40
O_3	3	5	4	2	4	1	60
O_4	4	2	2	1	2	2	30
Required	30	50	20	40	30	10	180

table 2b

3. Solve the following LPP by dynamic programming:
   Maximize Z = $50x_1+100x_2$,
   Subject to
   $$2x_1+3x_2 \leq 48,$$
   $$x_1+3x_2 \leq 42,$$
   $$x_1+x_2 \leq 21,$$
   $$x_1, x_2 \geq 0.$$ [16]

4. Discuss about various types of simulation models. [16]

5. (a) In a railway marshalling yard, goods train arrives at the rate of 30 trains per day. Assume that the inter arrival time follows an exponential distribution and the service time is also to be assumed as exponential with a mean of 36 minutes. Calculate

i. The probability that the yard is empty,

ii. The average length assuming that the line capacity of the yard is 9 trains.

(b) Discuss about kendall's notation of queuing model. [12+4]

6. A game has the payoff matrix

$$A = \begin{bmatrix} 0 & 2 \\ 1 & 1 \end{bmatrix}$$

Show that E(x,y)=1-2x(y-1/2) and deduce that in solution of the game the first player follows a pure strategy while the second has infinite number of mixed strategies. [8+8]

7. The demand for an item in a company is 18,000 units per year, and the company can produce the item at a rate of 3,000 per month. The cost of one setup is Rs.500 and the holding cost of one unit per month is 15 paise. The shortage cost of one unit is Rs.20 per year. Determine the optimum manufacturing quantity and the number of shortages. Also determine the manufacturing time and the time between setups. [16]

8. (a) Explain how the theory of replacement is used in the following problems:

i. Replacement of items whose maintenance cost varies with time.

ii. Replacement of items that fail completely.

(b) The following mortality rates have been observed for a certain type of fuse:

Week :	1	2	3	4	5
Percent failing by the end	5	15	35	57	100

There are 1,000 fuses in use and it costs Rs. 5 to replace an individual fuse. If all fuses were replaced simultaneously it would cost Rs 1.25 per fuse. It is proposed to replace all fuses at fixed intervals of time, whether or not they have burnt out, and to continue replacing burnt out fuses as they fail. At what intervals the group replacement should be made? Also prove that this optimal policy is superior to the straight forward policy of replacing each fuse only when it fails. [6+10]

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Code No: 07A7EC03 **R07** **Set No. 3**

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1. The annual demand of a product is 10,000 units. Each unit costs Rs.100 if orders are placed in quantities below 200 units but for orders of 200 and above the price is Rs. 95. The annual inventory holding costs is 10% of the value of the item and the ordering cost is Rs. 5 per order. Find the economic lot size. [16]

2. (a) Write about waiting lines.
   (b) A self-service store employs one cashier at its counter. Nine customers arrive on an average every 10 minutes while the cashier can serve 20 customers in 10 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service rate, find
      i. Average number of customers in the system.
      ii. Average number of customers in queue or average queue length.
      iii. Average time a customer spends in the system.
      iv. Average time a customer waits before being served. [6+10]

3. (a) Explain Johnson's method for determining the optimal sequence for processing n jobs on two machines.
   (b) Find the sequence that minimizes the total elapsed time, given the processing times in hours required to complete the following jobs as shown in the table below. Also compute the total elapsed time and idle times for each machine. [6+10]

Job:	1	2	3	4	5	6
Machine I:	4	8	3	6	7	5
Machine II:	6	33	7	2	8	4

4. (a) Give a general form of LPP.
   (b) Solve the following LPP by penalty Method
   Maximize Z = $x_1 + 2x_2 + 3x_3$ - x_4
   subject to the constraints
   $x_1 + 2x_2 + 3x_3 = 15$
   $2x_1 + x_2 + 5\ x_3 \geq 20$
   $x_1 + 2x_2 + x_3 + x_4 = 10$
   $x_1, x_2, x_3, x_4 \geq 0$. [6+10]

5. (a) Solve the game given in table by reducing to 2 × 2 game by graphical method.

Player B

Player A		I	II	III	IV	V
	I	3	0	6	-1	7
	II	-1	5	-2	2	1

(b) Which competitive situation is called a game? [10+6]

6. A manufacturing firm has a contract to supply lathe chucks as per the following schedule. The product made during a month will be supplied at the end of the month. The setup cost is Rs.1,000, while the inventory carrying cost is Rs.1.00 per piece per month. In which month should the batches be produced and of what size, so that the total of setup and inventory carrying costs are minimized? [16]

Month	No. of items
January	100
February	200
March	300
April	400
May	400
June	300

7. How can simulation help to optimize the inventory? [16]

8. (a) What are the situations which makes the replacement of items necessary?

(b) Madras Cola Inc. uses a bottling machine that costs Rs. 50,000 when new. Table below gives the expected operating costs per year in the annual expected production per year and the salvage value of the machine. The wholesale price for a bottle of drink is Re. 1.00.

Data Associated with Age of Bottling Machine

Age	1	2	3	4	5
Operating costs (Rs.) :	7,000	8,000	10,000	14,000	20,000
Production (Bottles) :	2,08,000	2,08,000	2,00,000	1,90,000	1,75,000
Salvage value (Rs.) :	30,000	19,000	15,000	12,000	10,000

When should the machine be replaced? [6+10]

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