

III B.Tech. II Semester Regular Examinations, April/May -2005
MATHEMATICAL MODELLING & SIMULATION
(Computer Science & Systems Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. A farm is engaged in breeding pigs. The pigs are fed on various products grown on the farm. In view of the need to ensure certain nutrient constituents (call them X, Y and Z), it is necessary to buy additional products, say, A and B. One unit of product A contains 36 units of X, 3 units of Y and 20 units of Z. One unit of product B contains 6 units of X, 12 units of Y and 10 units of Z. The maximum requirement of X, Y and Z is 108 units, 36 units and 100 units respectively. Product A costs Rs. 20 per unit and product B Rs. 40 per unit. Formulate the above as L. P. P. to minimize the total cost, and solve the problem by using graphic method.
2. (a) What is an assignment problem? Explain.

- (b) A departmental head has four subordinates, and four tasks to be performed. The subordinates differ in efficiency, and tasks differ in their intrinsic difficulty. His estimate, of the time each man would take to perform each task, is given in the matrix below:

Tasks	Men			
	E	F	G	H
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

How should the tasks be allocated one to a man, so as to minimize the total man - hours?

3. (a) Explain the decision rules for a purchase inventory model with two price breaks
- (b) Find the optimal order quantity for a product for which the price breaks are as follows:

Quantity	Unit cost(Rs.)
$0 \leq q_1 < 50$	Rs.10
$50 < q_2 < 100$	Rs.9
$100 < q_3$	Rs.8

The monthly demand for the product is 200 units, the cost of storage is 25% of the unit cost and ordering cost is Rs. 20 per order.

4. (a) Explain the basis of selective inventory control?
- (b) State the different selection techniques adopted in inventory control system. Give a brief note on each.
5. With respect to queuing theory, explain the following

- (a) Cost models in queuing theory
 - (b) Non-poisson queues.
6. (a) Explain PERT and its importance in network analysis. What are the requirements for applications of PERT techniques.
- (b) List at the differences between PERT and CPM
7. (a) What are the various tests used to ensure the desirable properties in random numbers
- (b) Generate a sequence of random numbers with
 $x_0 = 27$, $a = 17$, $c = 43$ and $m = 100$
8. Discuss the steps in the development of a useful model of input data with suitable example.

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1. (a) What is a model? Discuss various classification schemes of models.
 (b) Find all basic solutions for the problem

$$\text{Max } z = x_1 + 2x_2$$
 such that

$$x_1 + x_2 \leq 10$$

$$2x_1 - x_2 \leq 40$$

$$\text{and } x_1, x_2 \geq 0.$$
2. (a) Give the mathematical formulation of transpotation problem
 (b) Use Vogels approximation method to obtain an initial basic feasible solution of the transportation problem.

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

3. (a) Distinguish between static and dynamic inventory models. How can you estimate ordering costs and carrying costs?
 (b) Find the optimal order quantity for a product for which the price breaks are as follows:

Unit cost(Rs.)	Quantity
Rs. 1,000	$0 \leq q < 500$
Rs. 925	$500 \leq q < 14,000$
Rs. 875	$4,000 > q$

Ordering cost $C_3 = \text{Rs. } 35,000$ demand $R = 2,400$, time period $T = 360$ days and cost of storage = 0.06% of the unit cost.

4. Describe various selective inventory management techniques. Explain how these techniques can be combined to develop broad policy guidelines for selective control.
5. Patients arrive at a clinic according to a poisson distribution at a rate of 30 patients per hour. The waiting room does not accommodate more than 14 patients. Examination time per patient is exponential with mean rate of 20 per hour.
 - (a) Find the effective arrival rate at the clinic
 - (b) What is the probability that an arriving patient will not wait?

- (c) What is the expected waiting time until a patient is discharged form the clinic?
6. A PERT network has the following activities with their time estimates given below:

Activity	Optimistic (days)	Most likely (days)	Pessimistic (days)
0-1	2	3.5	8
0-2	3	3.75	6
0-3	1	2.5	7
1-2	3	7.5	9
1-5	4	5.5	10
2-4	2	5	8
3-4	2	2.75	5
3-5	3	6	9
4-5	2	5	8

- (a) Construct a network and find the expected completion time of the project.
- (b) Find the probability of completing the project 3 days ahead of the expected schedule.
7. List and discuss various periods in the history of simulation software
8. Discuss why validating a model of computer system might be easier than validating a military combat model. Assume that the computer system of interest is similar to an existing one.

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1. (a) Explain briefly the general methods for solving O. R. models.
- (b) Ozark Farms uses at least 800 lb of special feed daily. The special feed is a mixture of corn and soybean meal with the following compositions.

lb per lb of feed stuff			
Feed Stuff	Protein	Fiber	Cost(\$lb)
Corn	0.09	0.02	0.30
Soybean	0.60	0.06	0.90

The dietary requirements of the special feed stipulate atleast 30% protein and at most 5% fiber. Ozark Farms wishes to determine the daily minimum - cost feed -mix. Formulate it as an L. P. model

2. Explain briefly:

- (a) North - West corner rule
- (b) Minimum matrix method
- (c) Vogels approximation method,

for finding an initial basic feasible solution for a transportation problem.

3. (a) A news paper boy buys papers for 5 paise each and sells them for 6 paise each. He cannot return unsold news papers. Daily demand R for news papers follows the distribution:

R	10	11	12	13	14	15	16
P_R	0.05	0.15	0.40	0.20	0.10	0.05	0.05

If each day's demand is independent of the previous days, how many papers should be order each day?

- (b) Explain the following terms in inventory:
 - i. Lead time
 - ii. Re-order point
 - iii. Safety stock
4. Describe various selective inventory management techniques. Explain how these techniques can be combined to develop broad policy guidelines for selective control.
5. With respect to queuing theory, explain the following
 - (a) Birth and Death process

- (b) Priority - Discipline queuing models
 - (c) Role of exponential distribution
6. Construct a network for the following project.
- (a) A and B start immediately
 - (b) C and D follow A
 - (c) E follows D
 - (d) B and C precede G
 - (e) B, C and E precede F
 - (f) F and G are terminal activities
- Find the total float, free float and independent float for each activity. Also find the critical path, if the durations of activities A, B, C, D, E, F, G are respectively
3, 4, 6, 1, 3, 4, 2.
7. (a) Explain the role of state descriptor in discrete system simulation
- (b) Define the terms
- i. Discrete event
 - ii. Simulation time
 - iii. Clock time
- (c) Explain the representation of time in discrete system simulation
8. (a) Distinguish model verification and validation
- (b) Explain conceptual and operational model-building process.

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2. Solve the following transportation:

	1	2	3	4	Supply
1	2	3	11	7	6
2	1	0	6	1	1
3	5	8	15	9	10
Requirement	7	5	3	2	

3. A company uses annually 50,000 units of an item each costing Rs. 1.20. Each order costs Rs. 45 and inventory carrying costs 15% of the annual average inventory value.
Find E. O. Q.
If the company operates 250 days a year, the procurement time is 10 days and safety stock is 500 units. Find
 - (a) The reorder level
 - (b) Maximum inventory
 - (c) Minimum inventory
 - (d) Average inventory.
4. What is the ABC analysis? Why it is necessary? What are the basis steps in implementing it?
5. With respect to queuing theory, explain the following
 - (a) Cost models in queuing theory
 - (b) Non-poisson queues.

6. Construct a network for the following project.

- (a) A and B start immediately
- (b) C and D follow A
- (c) E follows D
- (d) B and C precede G
- (e) B, C and E precede F
- (f) F and G are terminal activities

Find the total float, free float and independent float for each activity. Also find the critical path, if the durations of activities A, B, C, D, E, F, G are respectively

3, 4, 6, 1, 3, 4, 2.

7. (a) What are the advantages and disadvantages of simulation
(b) Discuss any four application areas of simulation

8. The following table gives the number of aircraft accidents that occurred during the various days of the week. Test whether the accidents are uniformly distributed over the week.

Days	Mon	Tue	Wed	Thu	Fri	Sat
No. of Accidents	14	18	12	11	15	14
