

IV B.Tech I Semester Regular Examinations, November 2005
MATHEMATICAL MODELLING & SIMULATION
(Common to Computer Science & Engineering and Electronics & Computer Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Illustrate graphically the following special cases of L. P. P. [6+5+5=16]

- (a) Multiple optimal solutions
- (b) Feasible solutions
- (c) Unrestricted variable.

2. Solve the following transportation: [16]

	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) What are the types of inventory? Why they are maintained? [6]
- (b) A particular item has a demand of 9,000 units/year. The cost of one procurement is Rs. 100 and the holding cost per unit is Rs. 2.40 per year. The replacement is instantaneous and no shortages are allowed determine. [10]
- i. the economic lot size
 - ii. the number of orders per year
 - iii. the time between orders
 - iv. total cost per year if the cost of one unit is Rs. 1.
4. (a) State various types of items in inventory control techniques. [6]
- (b) The following thirty numbers represent the annual value in thousand of rupees of some thirty items of materials selected at random. Carry out an ABC analysis and list out the values of 'A' items only: [10]

1	2	4	9	75	4	25
3	6	13	2	4	12	30
100	2	7	40	15	55	1
11	15	8	19	1	20	1
3	5					

5. With respect to queuing theory, explain the following [8+8=16]

- (a) Cost models in queuing theory
- (b) Non-poisson queues.

6. A project has the following characteristics

[16]

Activity	Optimistic time (days)	pessimistic time (days)	Most likely time (days)
1-2	1	5	1.5
2-3	1	3	2
2-4	1	5	3
3-5	3	5	4
4-5	2	4	3
4-6	3	7	5
5-7	4	6	5
6-7	6	8	7
7-8	2	6	4
7-9	5	8	6
8-10	1	3	2
9-10	3	7	5

Construct a PERT Network. Find the critical path and variance for each event. Find the project duration at 95% probability.

- 7. (a) What is a pseudo-random number generator? How to construct it? [6]
- (b) What is an inverse transformation method? Where do you use it? [4]
- (c) Give any random number generation algorithm [6]
- 8. (a) Distinguish model verification and validation [4]
- (b) Explain conceptual and operational model-building process. [12]

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1. (a) Explain briefly the general methods for solving O. R. models. [6]
- (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 [10]

2. (a) Give an algorithm to solve an "Assignment" problem? [8]
- (b) What is an unbalanced assignment problem? Explain it with at least one example. [8]
3. (a) What are the types of inventory? Why they are maintained? [6]
- (b) A particular item has a demand of 9,000 units/year. The cost of one procurement is Rs. 100 and the holding cost per unit is Rs. 2.40 per year. The replacement is instantaneous and no shortages are allowed determine. [10]
 - i. the economic lot size
 - ii. the number of orders per year
 - iii. the time between orders
 - iv. total cost per year if the cost of one unit is Rs. 1.
4. (a) Explain ABC analysis. [8]
- (b) What are its advantages and limitations, if any. [8]
5. In the production shop of a company, the breakdown of the machines is found to be poisson with an average rate of 3 machines per hour. Breakdown time at one machine costs Rs.40/- per hour to the company. There are two choices before the company for hiring the repairmen, one of the repairmen is slow but cheap, the other fast but expensive. The slow-cheap repairman demands Rs.20/- per hour and will repair the broken down machines exponentially at the rate of Rs.4/- per hour. The fast-expensive repairman demands Rs.30/- per hour and will repair machines exponentially at an average rate of Rs.6/- per hour which repairman should be hired. [16]

6. (a) Define the terms: [8]
- i. Normal cost
 - ii. Crash cost
 - iii. Normal time
 - iv. Crash time
- (b) Define “Critical path”, “Slack time” and “Dummy activity” with reference to PERT and CPM. How can uncertainty be incorporated in PERT models. [8]
7. Explain the execution of simulation algorithm in [8+8=16]
- (a) SIM SCRIPT
 - (b) GPSS
8. Explain the process of calibration and validation of simulation models. [16]

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1. (a) What is a model? Discuss various classification schemes of models. [6]
(b) Find all basic solutions for the problem [10]
Max $z = x_1 + 2x_2$
such that
 $x_1 + x_2 \leq 10$
 $2x_1 - x_2 \leq 40$
and $x_1, x_2 \geq 0$.
2. Explain briefly: [5+5+6]
 - (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) Derive the E. O. Q. formula for the manufacturing model with shortages [6]
(b) A manufacturing firm has to supply 3,000 units annually to a customer who does not have enough space for storing the material. There is a contract that if the supplier fails to supply the material, a penalty of Rs. 40 per unit per month will be levied. The inventory holding cost amounts to Rs. 20 per unit per month and the setup cost is Rs. 400 per run. Find the expected number of shortages at the end of each scheduling period. [10]
4. (a) Describe the norms you would use for controlling inventories classified by ABC analysis. [6]
(b) Classify the following 14 items ABC categories: [10]

Code N O.	Monthly Consumption (in Rs.)
D-179-0	451
D-115-0	1,052
D-186-0	205
D-191	893
D-192	843
D-193	727
D-195	412
D-196	214
D-198-0	188
D-199	172
D-200	170
D-204	5,056
D-205	159
D-212	3,424

How the policies with regard to safety stocks order quantity, materials control and inventory system will be different for the items classified as A, B and C.

5. Consider a self service store with one cashier. Assume poisson arrivals and exponential service times. Suppose that a customer arrive on the average every 5 minutes and the cashier can serve 10 in 5 minutes. Find [16]

- (a) The average number of customers queuing for service
- (b) The probability of having more than 10 customers in the system
- (c) The probability that a customer has to queue for more than 2 minutes

If the service can be speeded upto 12 in 5 minutes by using a different cash register, what will be the effect on the quantities (a), (b) and (c)

6. (a) Explain PERT and its importance in network analysis. What are the requirements for applications of PERT techniques. [10]
- (b) List at the differences between PERT and CPM [6]
7. (a) Explain the role of state descriptor in discrete system simulation [6]
- (b) Define the terms [6]
- i. Discrete event
 - ii. Simulation time
 - iii. Clock time
- (c) Explain the representation of time in discrete system simulation [4]
8. Write a short notes on the following [6+5+5]
- (a) Output analysis of a single model

- (b) Chi-square test
- (c) Kolmogorov-Smirnov test.

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1. (a) Explain the concept of degeneracy in simplex method with at least one example? [4]
(b) Solve the following L. P. problem using Big M method: [12]
Minimize $z = 2x_1 + 5x_2$
subject to the constraints:
 $x_1 + x_2 = 100$
 $x_1 \leq 40$
 $x_2 \leq 30$
and $x_1, x_2 \geq 0$.
2. (a) What is a non - linear programming problem? Give two examples of NLPP stating clearly why do you so classify them? [10]
(b) Give canonical form of non - linear programming problem. [6]
3. (a) Derive the E. O. Q. formula for the manufacturing model with shortages [6]
(b) A manufacturing firm has to supply 3,000 units annually to a customer who does not have enough space for storing the material. There is a contract that if the supplier fails to supply the material, a penalty of Rs. 40 per unit per month will be levied. The inventory holding cost amounts to Rs. 20 per unit per month and the setup cost is Rs. 400 per run. Find the expected number of shortages at the end of each scheduling period. [10]
4. (a) Explain the basis of selective inventory control [6] ?
(b) State the different selection techniques adopted in inventory control system. Give a brief note on each. [10]
5. At a railway station, only one train is handled at a time. The railway yard is sufficient only for two trains to wait while others is given signal to leave the station. Trains arrive at the station at an average rate of 6 per hour and the railway station can handle them on an average of 12 per hour. Assuming poisson arrivals and exponential service distribution, find the steady-state probabilities for the various number of trains in the system. Also find the average waiting time of a new train coming into the yard. [16]
6. A PERT network has the following activities with their time estimates given below: [16]

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 [16]
8. Discuss the steps in the development of a useful model of input data with suitable example. [16]

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