

**III B.Tech II Semester Supplementary Examinations,
November/December 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) Write a short notes on the following: [6]
 - i. Analytical method
 - ii. Heuristic method.
- (b) Compute all the basic feasible solutions of the L. P. problem: [10]
 Maximize $z = 2x_1 + 3x_2 + 4x_3 - 7x_4$
 subject to the constraints:
 $2x_1 + 3x_2 - x_3 + 4x_4 = 8$
 $x_1 - 2x_2 + 6x_3 - 7x_4 = -3$
 and choose that one which maximizes z .
2. (a) Distinguish between pure and mixed integer programming problem. [4]
- (b) Find the optimal integer solution to the following all L.P. P. [12]
 Maximize $z = x_1 + 2x_2$
 subject to the constraints
 $2x_2 \leq 7$
 $x_1 + x_2 \leq 7$
 $2x_1 \leq 11$
 $x_1, x_2 \geq 0$ and x_1, x_2 are integers.
3. What are the costs associated with inventory? Distinguish between deterministic and stochastic models in inventory theory. [16]
4. What is the ABC analysis? Why it is necessary? What are the basis steps in implementing it? [16]
5. A super market has two girls serving at the counters. The customers arrive in poisson fashion at the rate of 12 per hour. The service time for each customer is exponential with mean 6 minutes. Find [16]
 - (a) The probability that an arriving customer has to wait for service.
 - (b) The average number of customers in the system.
 - (c) The average time spent by a customer in the super-market.
6. What is 'Critical Path'? When is any sequence of activities is a critical path? Why should we want to know which activities are critical and which are not? Can a critical path change during the course of a project? Why? [16]

7. (a) Define system simulation? [2]
(b) Discuss different types of simulation models [8]
(c) Define discrete and continuous systems. Also give suitable examples [6]
8. Explain the iterative process of calibrating a model with a schematic diagram. [16]

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1. (a) What are various phases of O. R. problem? Explain them briefly? [6]
 (b) A toy manufacturer produces two types of dolls: a basic version doll A and a deluxe version doll B. Each doll of type B takes as long to produce as one doll of type A. The company have time to make a maximum of 2000 dolls per day and each type requires equal amount of it. The deluxe version, i.e. type B requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 30 and Rs. 50 per doll, respectively on doll A and B; how many of each should be produced per day in order to maximize profit? Solve it by graphic method. [10]
2. (a) Give the mathematical formulation of transportation problem [4]
 (b) Solve the following transportation problem : [12]

	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) 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: [10]

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: [6]
 - 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. [16]
5. (a) List out the major decisions to be made and decision variables involved in designing a typical queuing system. [7]

- (b) Explain the relationship between the following with graphs with respect to queuing theory [9]
- Service cost and Level of Service
 - Expected waiting time and Level of Service
 - Expected waiting time and cost of service per arrival
6. A small maintenance project consists of the following 12 jobs with duration in days. Summarize the CPM calculations in standard tabular form calculating total, free and independent floats of the jobs. [16]

Job	Duration
1-2	2
3-4	3
5-8	5
7-9	4
2-3	7
3-5	5
6-7	8
8-9	1
2-4	3
4-6	3
6-10	4
9-10	7

7. Explain the execution of simulation algorithm in [8+8=16]
- SIM SCRIPT
 - GPSS
8. Compare validation in simulation to the validation of theories in the physical sciences. [16]

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1. (a) Define slack and surplus variables as involved in the L. P. P. How are these variables useful in solving a L. P. P. [4]
- (b) Solve the following L. P. P. by simplex method : [12]
 Maximize $z = 4x_1 + x_2 + 4x_3 + 5x_4$
 subject to the constraints
 $4x_1 + 6x_2 - 5x_3 + 4x_4 \geq -20$
 $3x_1 - 2x_2 + 4x_3 + x_4 \leq 10$
 $8x_1 - 3x_2 - 3x_3 + 2x_4 \leq 20$
 and $x_1, x_2, x_3, x_4 \geq 0$.
2. (a) What is an integer linear programming problem? How does the optimal solution of integer programming problem compare with that of linear programming problem? [8]
- (b) State the general form of an integer programming problem? [8]
3. What are the costs associated with inventory? Distinguish between deterministic and stochastic models in inventory theory. [16]
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. 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 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. Explain various steps involved in simulation study [16]
8. Discuss the steps in the development of a useful model of input data with suitable example. [16]

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2. (a) How the problem of degeneracy arises in a transportation? Explain how does one over come it? [4]

- (b) Consider the following unbalanced transportation problem?

	1	2	3	Supply
1	5	1	7	10
2	6	4	6	80
3	3	2	5	15
Demand	75	20	50	

Since there is not enough supply, some of the demands at these destinations may not be satisfied. Suppose there are penalty costs for every unsatisfied demand unit which are given by 5, 6 and 2 for destination 1, 2 and 3 respectively. Find the optimal solution. [12]

3. (a) Describe the basic characteristics of inventory system. [4]
- (b) A company has a demand of 12,000 units/year for an item and it can produce 2000 such items per month. The cost of one setup is Rs. 400 and the holding cost / unit/ month is Rs. 0.15. Find the optimum lot size and the total cost per year, assuming the cost of 1 unit as Rs. 4. Also, find the maximum inventory. [12]
4. (a) Explain ABC analysis. [8]
- (b) What are its advantages and limitations, if any. [8]
5. In a car-wash facility, cars arrive for service according to a poisson distribution with mean 5 per hour. The time for washing and cleaning each car varies but is found to follow an exponential distribution with mean 10 minutes per car. The facility cannot handle more than one car at a time and has a total of 5 parking spaces. [16]

- (a) Find the effective arrival rate
 - (b) What is the probability that an arriving car will get service immediately upon arrival?
 - (c) Find the expected number of parking spaces occupied.
6. Construct a network for the following project. [16]
- (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) Define system simulation? [2]
(b) Discuss different types of simulation models [8]
(c) Define discrete and continuous systems. Also give suitable examples [6]
8. (a) What is the importance of Histograms in input modeling? How do you construct a Histogram. [12]
(b) List out various probability distributions used in input modeling. [4]
