

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV/ II	Time	3 hrs.

Subject: - Simulation and Modelling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain various steps in simulation study with block diagram. List the advantages of simulation. [6+2]
2. Describe the explain dynamic mathematical model with necessary mathematical equation and diagram. [6]
3. Define feedback system. Explain the analog method for liver with necessary equations and figure. [2+8]
4. Explain queuing system and its applications. Explain Kendall notation in queuing systems. What is the meaning of D/M/1/LIFO/20/80. [6+2+2]
5. Discuss the features of Markov chain. Explain the application of Markov chain with suitable example. [3+3]
6. Write the properties of random number. A sequence of five-digit numbers has been generated and an analysis indicates the following combination observation: All same 15, all different 3570, exactly one pair 4400, exactly two pairs 1100, three of a kind 800, four of a kind 35 and full house 80. Based on the poker test, are these numbers independent at $\alpha = 10\%$ (chi square table value for $\alpha = 5\%$, $df = 6$ is 12.59). [3+5]
7. What do you mean by poker test? A sequence of 10,000 five-digit numbers has been generated and an analysis shows following combinations and frequencies. Based on Poker test, test these numbers are independent or not for $\alpha = 0.05$. (Use 12.59 as Tabular Value). [2+8]

Combinations	Observed Frequency
All different Digits	3054
One Pair	5020
Two Pairs	1073
Three of a kind	710
Full House	95
Four of a kind	44
Five of a kind	4

8. Explain with an example the iterative process of calibrating of model. [5]
9. Explain the replication of runs method for a single-server queue (M/M/1) simulation. [5]
10. Explain simulation in Java using a single server queue model. [6]
11. How memory simulation is done in computer system? Explain with example. [6]

Exam.	Back	
Level	BE	Full Marks 80
Programme	BCT	Pass Marks 32
Year / Part	IV / II	Time 3 hrs.

Subject: - Simulation and Modelling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define system, model and simulation. Explain the various steps of simulation study with flowchart. [3+5]
2. Explain the static mathematical model with practical example. [6]
3. Design and explain the analog computer model of liver with necessary diagram and equations. Discuss the feedback system with example. [6+2]
4. Define queuing system. Discuss the different types of queuing disciplines and also explain the different performance measures for evaluation of queuing system. [2+3+5]
5. Given that, if a user owns a Pulsar today, there's an 80% chance they will buy a Pulsar again next time, and a 20% chance they will switch to Yamaha. If a user owns a Yamaha today, there's an 85% chance they will buy a Yamaha again next time, and a 15% chance they will switch to Pulsar. [6]
 - a) If a user owns a Yamaha today, what is the probability that they will buy a Pulsar after 3 purchases?
 - b) If 60% of users own a Pulsar today, what percentage of users will own a Pulsar after 3 purchases.
6. A sequence of 10,000 five-digit numbers has been generated and an analysis shows following combinations and frequencies. Based on Poker test, test these numbers are independent or not for $\alpha = 0.05$. (Use 12.59 as tabular value). [8]

Combinations	Observed Frequency
All different Digits	3054
One Pair	5020
Two Pairs	1073
Three of a kind	710
Full House	95
Four of a kind	44
Five of a kind	4

7. Define pseudo-random numbers. What are the problems that occur in the generation of pseudo random numbers? Explain linear congruential method for generating random numbers with example. [10]
8. Explain the process of model building, verification and validation. [6]
9. Discuss the use of estimation method in analysis of simulation output. [6]
10. Explain the Java simulation of a single server queue with flowchart. [6]
11. Describe the CPU simulation with example. [6]

TRIBHUVAN UNIVERSITY
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Examination Control Division
2081 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV/ II	Time	3 hrs.

Subject: - Simulation and Modelling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the various steps in simulation study with flowchart. List of the advantage and disadvantages of simulation. [6+2]
2. Explain the dynamic mathematical model with practical example. [6]
3. Discuss the advantages and disadvantages of analog computer. Draw the analog computer model of any continuous system with equation and explanations. [3+7]
4. Explain the queuing system with necessary block diagram. Discuss the Kendall notation in queuing systems. What is the meaning of M/D/6/20/1000/LIFO. [6+2+2]
5. Given that a chance of Ford car user to buy a Ford car in next purchase is 70% and that his next purchase is will be a Scorpio is 30% and chance of Scorpio car user to buy Scorpio car at the next purchase is 80% and chance that his next purchase will be Ford car is 20%. [6]
 - a) Make graph of above problem and construct a transition matrix.
 - b) What is the probability to buy a Scorpio car after three purchase of a current Ford user?
 - c) If 70% user use Ford car today, what percentage of user will use Scorpio after 3 purchase?
6. A sequence of 1000 four-digit numbers has been generated and an analysis indicates the following combinations & frequencies: [8]

Combination Distribution (i)	Observed Frequency (O _i)
4 different digits	540
3 like digits	50
4 like digits	20
1 pair	320
2 pair	70

Use Poker's test to determine if these random numbers are independent, $\alpha = 0.05$. At $\alpha = 0.05$, acceptable value of χ^2 from table = 9.49.
7. Write down an algorithm of Gap test. Perform uniformity test using KS test with a level of significance $\alpha = 0.05$ on the following five generated numbers. [5+5]
0.44, 0.81, 0.14, 0.05, 0.93 (for $\alpha = 0.05$, Tabular value = 0.565)
8. Explain the Naylor and Finger's approach used in validation process. [5]
9. How can you analyze simulation output using simulation run statistics? Explain with practical example. [5]
10. Explain the single server queuing simulation model using JAVA. [6]
11. Explain the different level of abstractions in computer system simulation. [6]

TRIBHUVAN UNIVERSITY
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2080 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define simulation. Explain the various steps in simulation study with diagram. [2+6]
2. Explain Static Mathematical model and dynamic mathematical model with example. [8]
3. Define feedback system. Design and explain the analog computer model of the liver with necessary block diagram and equations. [2+6]
4. Define and explain Queuing system. Explain Kendall Notation using D/M/1/FIFO/8/50. [5+3]
5. Explain Markov-Chain process with its features. Given that chance of a Hyundai Creta car user to buy Hyundai Creta car at next purchase is 70% and that his next purchase will be Tata Nexon EV car is 30%. The chance of Tata Nexon EV car user to buy Tata Nexon EV car at next purchase is 80% and that his next purchase will be Hyundai Creta car is 20%. What is the probability to buy Tata Nexon EV car after three purchase of a current Hyundai Creta car user? Also make necessary transition diagram of above problem. [5+3]
6. State the various test for random numbers and explain briefly any one of uniformity test method. [4+6]
7. A sequence of 1000 four-digit numbers has been generated and an analysis indicates: Based on Poker test, test these numbers are independent for $\alpha = 0.05$. (Use 9.49 as Tabular Value) [8]

Combinations (i)	Observed Frequency (O _i)
Four Different Digits	540
One Pair	320
Two Pair	70
Three like Digits	50
Four like Digits	20

8. Explain Naylor and Finger's approach used in validation. [5]
9. Explain the replication of runs with example. [5]
10. What do you mean by simulation software ? Explain at least three GPSS diagram with one example. [2+4]
11. What is the different level of abstraction for the simulation of computer systems? [6]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Shrawan

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain various steps in simulation study with block diagram. List the advantages and disadvantages of simulation. [6+2]
2. Explain dynamic mathematical model and compare with static mathematical model. [8]
3. Define analog method. Explain the analog computer model of automobile suspension problem with necessary diagram and equations. [2+6]
4. Explain the elements of Queuing system. Explain Kendall Notation using M/M/3/20/1500/FCFS. [5+3]
5. Explain the Markov chains with example and its applications. [8]
6. Define the good properties of pseudo random numbers. Discuss the steps of gap test algorithm with your own example. [4+6]
7. Define and develop a Poker test for four-digit random numbers. A sequence of 10,000 random numbers, each of four digits has been generated. The analysis of the numbers reveals that in 5120 numbers all four digits are different, 4230 contain exactly one pair of like digits, 560 contain two pairs, 75 have three digits of a kind and 15 contain all like digits. Use Poker test to determine whether these numbers are independent. (Critical value of chi-square test for $\alpha=0.05$ and $N=4$ is 9.49). [8]
8. Explain about errors in experimental data in validation process. [5]
9. Explain the simulation run statistics and its applicability in simulation output analysis. [5]
10. Explain brief on simulation in Java with flowchart. [6]
11. Discuss about memory simulation with example. [6]

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2079 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Differentiate between Simulation and Modeling. Draw the flowchart representing phases in simulation study and explain the model building phase. [2+6]
2. Differentiate between static mathematical model and dynamic mathematical model with necessary mathematical equation and a practical example of each model. [6]
3. Define analog method. Explain with the example of Automobile suspension problem. Discuss the advantages of analog computer over digital computer. [2+5+3]
4. Explain the characteristics of queuing system. What is the meaning of M/D/6/10/FIFO in queuing system? A barber with a one-man shop takes exactly 30 minutes to complete one haircut. If customers arrive according to a Poisson process at a rate of one every 40 minutes, how long on the average must a customer wait for service? [4+2+4]
5. Explain Markov chain with example. Given that a chance of Tesla car user to buy a Tesla car in next purchase is 60% and that his next purchase will be a BMW is 40% and chance of BMW car user to buy BMW car at the next purchase is 85% and chance that his next purchase will be Tesla car is 15%.
 - a) Make transition diagram of above problem and construct a transition matrix.
 - b) What is the probability to buy a BMW car after three purchase of a current Tesla car user? [3+5]
6. Write an algorithm of Kolmogorov-Smirnov test. Perform Kolmogorov-Smirnov test for the following random numbers with level of significance of $\alpha = 0.05$. Random numbers are: 0.45, 0.16, 0.29, 0.98, 0.45, 0.13, 0.63, 0.75, 0.11, 0.38. (The critical value for $\alpha = 0.05$ is 0.410 for sample size $N = 10$) [8]
7. Use mixed congruential method to generate a sequence of six random numbers with $X_0 = 27$, $a = 17$, $m = 100$ and $c = 43$. Explain Poker test steps for three digit numbers. [3+5]
8. Explain Naylor and finger validation approach. [5]
9. Explain the method for elimination of initial bias with example. [5]
10. Explain Simulation in GPSS with example. [6]
11. Explain CPU simulation with example. [6]

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Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. Define modeling and simulation. What are the various steps in simulation study? Illustrate with the flowchart. [3+5]
2. Explain dynamic mathematical model with practical example. [6]
3. Define analog method. Explain the analog computer model of liver with necessary diagrams and equations. [2+8]
4. Explain elements of a queuing system. Define system utilization. Explain Kendall Notation for queuing system with an example. [5+1+4]
5. Explain Markov chain with transition probability. What are the features and applications Markov chains? Explain with example. [3+5]
6. What do you mean by pseudo random number? How is it different from true random number? What are the requirements for good pseudo random number generator? Explain with example. [3+5]
7. A sequence of random numbers is given below. Use Chi-Sq. test with $\alpha = 0.10$ to test whether these numbers are serially auto-correlated or not. Use $X^2_{0.10,7} = 12.017$, $X^2_{0.10,8} = 13.362$, $X^2_{0.10,6} = 1.3645$, $X^2_{0.10,9} = 14.684$. [8]
39,65,27,48,85,66,11,53,38,59,5,72,15,45,80,73,60,94,56,24,36,76,46,40,77,42,87,32,57,
63,62,31,64,96,75,4,99,78,10,13,3,30,22,35,55,18,84,49,51,34,83,19,43,21,2,37,52,89,33,
47,67,41,16,95,54,100,74,71,81,68,1,61,20.
8. Explain Naylor and Finger's steps used in validation. [5]
9. Explain the replication of runs for analysis of simulation outputs. [5]
10. Explain Simulation in JAVA for signal server queue. [6]
11. Explain different levels of abstraction for simulation of computer system. [6]

TRIBHUVAN UNIVERSITY
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2079 Jestha

Exam.	Back		
Level	BE	Full Marks	80
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Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
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1. Define Simulation and Modeling. What are the advantages and disadvantages of Simulation? [2+4]
2. Compare static and dynamic mathematical models with example. [6]
3. Define hybrid simulation. Explain analog simulation model of a liver. [2+6]
4. Define queueing system. Explain Kendal's notation. Attendants in a workshop manage the tool cribs as mechanics, assumed to be from an infinite calling population, arrive for service. Assume poisson arrivals at the rate of 2 mechanics perminute and exponentially distributed service times with mean 40 seconds. Calculate the optimum number of attendants required and the probability of having zero mechanics in the system. [3+3+5]
5. List the characteristics of Markov Chain. Explain application of Markov Chain with an example. [4+6]
6. A set of 10,000 4-digit random values have been generated. An observation shows that 4731 values have all different digits, 2272 have 2 of a kind digits, 769 have 3 of a kind, 1547 have 2 pairs and 681 have all same digits. Test these values for randomness using Poker test (Use 9.49 as critical value). [8]
7. Explain three step validation in detail. [7]
8. Explain elimination of initial bias with example. [6]
9. What do you mean by simulation software? Explain basic blocks of GPSS. [3+7]
10. Explain different levels of abstraction to be considered in simulation of a computer. [8]

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2078 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Explain with various steps of simulation study. List advantages of simulation study. [6+2]
2. Explain dynamic physical model with practical example. [6]
3. Why differential equations are important in simulation and modeling? What is analog computer? Explain the analog method for automobile suspension problem with necessary equations and figure. [2+2+6]
4. Discuss the elements of queuing systems and its applications. Define the meaning of D/M/1/LIFO/20/80. [8+2]
5. Given that a chance of a Honda user to buy a Honda in next purchase is 60% and that his next purchase will be Yamaha or Bajaj is 30% and 10% respectively. Also if a chance of a Yamaha user to buy a Yamaha in next purchase is 70% and that his next purchase will be Bajaj or Honda is 10% and 20% respectively and a chance of a Bajaj user to buy Bajaj in next purchase is 65% and that his next purchase will be Honda or Yamaha is 20% and 15% respectively.
 - a) Design the Markov Model for the given Scenario. [3]
 - b) What is the probability to buy Honda after two purchases for a current Yamaha user? [3]
6. What do you mean by uniformity test? Explain the process of uniformity test of random numbers by K-S method, using your own example. [2+8]
7. A sequence of 1000 four digit numbers were generated as follows: [8]

Combination	Observed Frequency
All different digits	540
One pair	320
Two pair	70
Three of a kind	50
All same digits	20

Use poker test to check independence. (Use tabulated value as 9.488 for confidence of 95% and $N = 4$).

8. Comparison between verification and Validation with example. [5]
9. What are the various methods used to analyze simulation output? Explain any one of them. [5]
10. Explain at least 4 GPSS block diagram symbols. [6]
11. What are the different levels of abstraction for simulation in computer system? [6]

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2078 Kartik

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Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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- ✓ Assume suitable data if necessary.

1. When do we use Simulation? What are the different phases in Simulation Study? Explain. [2+6]
2. Explain Static mathematical model and Dynamic mathematical model with example. [8]
3. When are analog computers preferred over digital computers? Explain the analog computer model of an automobile suspension problem with necessary equation and figure. [2+8]
4. What is Kendall's Notation in queuing system? Give any two examples. Consider a single server queue where given customer arrival rate is 25/hr and service rate is 35/hr. Calculate its system utilization and average waiting time in the queue. Comment on the result. [4+6]
5. Explain transition matrix in Markov Chain with suitable example. Write any two features of Markov Chain. [4+2]
6. A sequence of 10000, 5 digit number has been generated and analysis indicates the following combinations and frequencies:

Combination	Observed Frequency O_i
Five different digits	2900
One pair	5100
Two pair	872
Three of a kind	990
Four of a kind	8
Full house	120
Five of a kind	10

Based on poker test, test these numbers are independent or not at a confidence level of 95%. For $\alpha = 0.05$ and degree of freedom = 6, chi square tabulated is 12.592. [8]

7. What are different random number generation methods? Explain with examples. [8]
8. Explain Naylor and Finger validation approach. [5]
9. How is the estimation method used in simulation output analysis? [5]
10. Explain about simulation in Java with single server queue model example. [6]
11. Explain about the simulation of website server system. [6]

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2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
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Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What are the advantages of simulation? Explain briefly the steps in simulation study. List the areas of application of simulation. [2+4+2]
2. Explain Static Mathematical Model with a practical example. [8]
3. Why do we need digital-analog simulator? Explain the analog model at automobile suspension problem with equation and diagram. [4+4]
4. Discuss about characteristics and applications of queuing system. What do you mean by D/M/6/FIFO/25/3000 in queuing notation? [5+3]
5. Explain markov chain process, its features and applications with example. [8]
6. A sequence of 1000 four-digit numbers has been generated and an analysis indicates the following combinations and frequencies: [8]

Combination (i)	Observed Frequency (O _i)
4 different digits	540
3 like digits	50
4 like digits	20
1 pair	320
2 pairs	70

Use Poker's test to determine if these random numbers are independent at $\alpha = 0.05$. Given critical value of χ^2 at $\alpha = 0.05$ and degree of freedom = 4 is 9.49.

7. Write the algorithm of Kolmogorov-Smirnov test. Use the Kolmogorov-Smirnov test for the following random numbers with level of significance of $\alpha = 0.05$ is 0.432 for sample size $N = 9$. Random numbers are: 0.37, 0.55, 0.71, 0.97, 0.65, 0.29, 0.84, 0.78, 0.23 [4+6]
8. Explain iterative process of calibrating a model. Why is it done? [5]
9. Explain replications of runs in simulation output analysis. [5]
10. What is GPSS? Explain four general blocks used in GPSS with an example. [6]
11. Explain different levels of abstraction for the simulation of computer system. [6]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the steps of Simulation study. [8]
2. Explain Static mathematical model and dynamic mathematical model with example. [6]
3. What is analog method? Explain with the example of Automobile suspension problem. [2+8]
4. What are the characteristics of Queuing system? What do you mean by Kendall notation in queuing system? What is the meaning of M/D/8/15/1000/LIFO? [4+3+3]
5. Given that a chance of a Ford car user to buy a ford car in next purchase is 70% and that his next purchase will be a Scorpio car is 30% and chance of a Scorpio car user to buy a Scorpio car at the next purchase is 80% and chance that his next purchase will be ford car is 20%. What is the probability to buy a Scorpio car after three purchase of a current Ford car user? If 70% user uses Ford car today, what percentage of user will use Scorpio after 3 purchases? [6]
6. Why do we use gap test? A sequence of 1000 four-digit numbers has been generated and an analysis indicates the following combinations and frequencies: Use Poker's test to determine if these random numbers are independent, $\alpha = 0.05$ and $n = 4$ such that $\alpha_{(0.05,4)} = 9.49$. [2+8]

Combination Distribution (i)	Observed Frequency
4 different digits	540
3 like digits	50
4 like digits	20
2 Pairs	70
1 Pair	320

7. What are different random number generation methods. Explain with examples. [8]
8. Explain with example the iterative process of calibrating of model. [5]
9. How can you use estimation methods in analysis of simulation output? Explain with example. [5]
10. Briefly explain about simulation in Java. [6]
11. Explain CPU simulation with example. [6]

Examination Control Division

2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is simulation? Explain the steps of Simulation Study with flowchart. [2+6]
2. Differentiate between static mathematical model and dynamic mathematical model with suitable examples. [6]
3. Write down the significance of differential equations. Explain the analog computer model of liver with necessary equation and diagrams. [4+6]
4. Define queuing system with block diagram and its uses. Explain M/M/4/20/2000/FCFS and D|M|2|LIFO|18 system. [6+2+2]
5. Given that change of a Sony user to buy Sony at next purchase is 80% and that his next purchase will be Samsung is 20% and chance of a Samsung user to buy Samsung at next purchase is 85% and chance that his next purchase will be Sony is 15%. What is the probability to buy Sony after three purchase of a current Samsung user? If 60% user uses Sony today, what percentage of user uses Samsung after three purchase? [4+2]
6. What are the properties of random number? Explain the techniques of generation of random number with appropriate example. [2+6]
7. What are the properties of Random number? Using Chi-Square test the uniformity at 90% for the given random numbers. Degree of freedom for 6 = 10.645, 7 = 12.017, 8 = 13.362, 9 = 14.684, 10 = 15.987. [3+6]

20	34	43	42	14	10	33	17	6	11
15	16	4	1	35	22	9	46	37	57
51	49	40	27	59	5	44	19	41	55
53	29	3	31	48	8	56	28	12	7

8. Explain about the Calibration and Validation of Models. [5]
9. Explain the structure of Java Simulation with example. [6]
10. How you can analyze simulation output using simulation runs statistics? Explain [6]
11. Explain CPU simulation with example. [6]

Exam.	Back		
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Subject: - Simulation and Modeling (CT753)

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- ✓ Attempt All questions.
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1. Explain with steps of simulations study. List advantages of simulation study. [6+2]
2. Explain dynamic physical model with necessary equations and diagrams. [6]
3. What is analog method? Design and explain analog computer model of liver with example. [2+8]
4. Explain the queuing notation with at least two examples and also explain about possibility of default values for notation. Explain about different elements of Queue System. [5+5]
5. Design markov model and transition matrix for given data. Answer following questions based on the model. [2×3]
 - a. If a person purchase coke now the probability of purchase of coke next time is 80%.
 - b. If a person purchase pepsi now the probability of purchasing pepsi next time is 70%.

Problems:

- i. Find the probability of using coke for a current pepsi user in 4th purchases.
 - ii. Find the probability for a person using pepsi now for a current pepsi purchaser after 4 purchases.
 - iii. A population of 5250 (Out of 10200) in a study of soft drink user uses coke now, find the population of purchasing pepsi in 4th purchases.
6. Explain the different congruential random number generation methods with example. Explain rejection method. [5+3]
 7. Write an algorithm for Gap Test. A sequence of 10,000 five digit numbers has been generated and analysis indicates the following combinations and frequencies. Based on Poker Test check whether the number are independent. Use $\chi^2_{0.05,6} = 12.592$ [4+6]

Combinations	Observed Frequencies
All Different	3044
One pair	5020
Two pair	1090
Three of a kind	700
Full house	95
Four of a kind	40
Five of a kind	11
Total	10,000

8. Comparisons between verification, validation and calibration of a model using example. [5]
9. Why do we need Replications of Runs, explain with example. [5]
10. Explain at least 5 CPSS block diagram symbols. [6]
11. Discuss memory simulation with example. [6]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the different components of system with example. Write down the advantages and disadvantages of Simulation. [4+4]
2. Differentiate between Static mathematical model and dynamic mathematical model with suitable examples. [6]
3. Why differential equations are important in scientific and engineering studies? Explain the analog method for Automobile Suspension Problem with necessary equations and figure. [4+6]
4. What is a queuing system? List the various characteristics of queuing system. Explain role of queuing system in simulation study. Explain Kendall notation with example. [2+2+2+4]
5. Define Markov chain. List the key feature and application of Markov chain. [2+4]
6. What are different random number generation methods? Explain with examples. [8]
7. What are the properties of Random numbers? Explain the algorithm of Kolmogorov-Smirnov Test with example. [4+6]
8. Explain Naylor and Finger validation approach. [5]
9. Explain the simulation Run statistics with example. [5]
10. Explain the single server queuing simulation model using JAVA. [6]
11. Explain about simulation of a central processing unit for the lower level of abstraction. [6]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT 753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Define system, model and simulation. And clarify with suitable example. List various advantage and disadvantage of simulation? [3+1+4]
- Explain dynamic physical model with example. [6]
- Design and explain analog method of automobile suspension problem? Explain feedback system with suitable example? [6+4]
- What is queuing model, explain with figure? What is the meaning of M/D/2/60/150/FIFO in queuing notation? Explain the Kendall notation with example. [3+2+5]
- Write down the application of Markov chains? Given that chance of a Sony user to buy Sony at next purchase is 75% and that his next purchase will be Samsung is 25% and chance of a Samsung user to buy Samsung at next purchase is 85% and chance that his next purchase will be Sony is 15%. What is the probability to buy Sony user after three purchase of a current Samsung user? [2+4]
- A sequence of 1000 four digit number has been generated and an analysis indicates the following combination and frequencies: [8]

Combination (i)	Observed Frequency (O _i)
Four different digit	520
One pair	390
Two pair	55
Three like digit	34
Four like digit	1
	1000

- What do you mean by pseudo random numbers? Explain Gap test algorithm with example. [2+8]
- Explain the iterative process of calibrating a model with example. [5]
- How can you use estimation method in analysis of simulation output? Explain with example. [5]
- Explain the overall structure of Java Simulation of a Single Server Queue. [6]
- Explain the simulation model of computer system that services request from www. [6]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is Simulation and Modeling? Explain when simulation is appropriate and not appropriate tool. [2+6]
2. Explain static mathematical model with suitable example. [6]
3. What is analog computer; explain with its pros and cons. Explain the analog computer model for liver with necessary figures. [4+6]
4. What are the characteristics of queuing system? Discuss any one practical application of queuing system. [5+5]
5. What are the key features of Markov chain? Given that chance of a Honda Bike user to buy Honda Bike at next purchase is 70% and that his next purchase will be Yamaha Bike is 30% and change of a Yamaha Bike user to buy Yamaha Bike at next purchase is 80% and change that his next purchase will be Honda Bike is 20%. What is the probability to buy Yamaha Bike after three purchase of a current Honda Bike user? [2+4]
6. What are the properties of random numbers? Explain the steps of Gap test algorithm with example. [4+6]
7. A sequence of 10,000 five digital numbers has been generated and analysis indicates the following combinations and frequencies. [8]

Combinations (i)	Observed Frequency (O _i)
All different	3450
One pair	4510
Two pair	1150
Three of a kind	750
Full house	85
Four of a kind	40
Five of a kind	15
Total	10,000

Based on Poker Test Check whether the number are independent. Use $\alpha = 0.05$ and $N = 6$ is 12.592

8. What is calibration and validation of models? Explain with practical example. [5]
9. Define initial Bias. Explain the methods for the elimination of initial bias. [5]
10. Explain in brief the simulation in JAVA with example. [6]
11. Explain the different level of abstraction for the simulation of computer system. [6]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. What is simulation? Describe general steps in simulation study. [8]
2. Explain dynamic mathematical model with example. [6]
3. What is continuous system simulation? Explain analog computer with practical example. [4+6]
4. What are the characteristics of queuing system? What is the meaning of D/M/1/LIFO/20/510 in queuing system? Write down the application of queue? [5+3+2]
5. What is Markov chain? Find the transition probability of a Pepsi user who will buy Coke on third purchase. Transition probability is as below: [6]

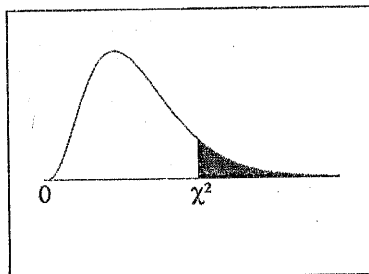
	Pepsi	Coke
Pepsi	0.7	0.3
Coke	0.1	0.9

6. What assumptions should we made while generating pseudo-random numbers? Write an algorithm for Gap Test with example. [4+6]
7. A sequence of 1000 four digit numbers has been generated and an analysis indicates the following conditions. Based on poker test, are these numbers independent? (use $\alpha=0.05$ and $N = 4$ is 9.488) [8]

Combination Distributions	Observed Frequency
4 different Digits	510
3 Like Digits	40
4 Link Digits	5
1 Pair	410
2 Pair	35

8. Explain steps in model building, verification and validation with diagrams. [5]
9. How it can be eliminated in simulation output analysis? [5]
10. Explain the different features that are relevant when selecting simulation software. [6]
11. Explain simulation of CPU with example. [6]

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_{\alpha}$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the steps in simulation study. What are the major differences between stochastic simulation and deterministic simulation? [4+4]
2. What is static mathematical model? Explain with example. [6]
3. What is a continuous system model? Explain the automobile suspension problem with example. [4+6]
4. What are the elements of queuing system? How can you measure the system performance of queuing system? Explain. [5+5]
5. What do you mean by Markov Chains? Explain with internet applications. [6]
6. Why Gap test is used? Explain Gap Test algorithm with example. [2+8]
7. A sequence of 1000 four digit numbers has been generated and analysis indicates the following combinations and frequencies: [8]

Combination (i)	Observed Frequency (O_i)
Four different digits	560
One pair	360
Two pairs	54
Three like digits	25
Four like digits	1
	1000

Based on poker test check whether the numbers are independent. Use $\alpha = 0.05$ and $N = 4$ is 9.49.

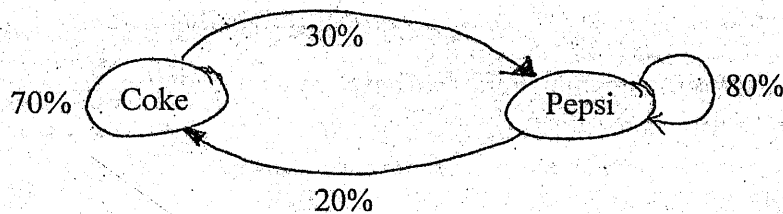
8. Explain with example of Naylor and Finger validation process. [5]
9. How can you use replications of runs in an analysis of simulation output? Explain with example. [5]
10. Explain the simulation in SSF with example. [6]
11. Explain the simulation model of computer system that services request from the World Wide Web (WWW). [6]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modelling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is simulation and modelling? Explain the steps in simulation study. [2+6]
2. Explain the dynamic physical model with example. [6]
3. What is analog method? Explain with example of automobile suspension problem. [4+6]
4. What is the model of queuing system? What do you mean by the Kendall's notation in queuing systems? What is the meaning of M/D/8/15/LIFO in queuing system? Explain. [5+2.5+2.5]
5. Given figure shows Coke and Pepsi purchaser [6]



- a) If currently Coke purchaser, what is the probability of Pepsi purchaser in 3rd purchase?
- b) If 55% of people use Coke today, what percentage of people will use Coke after 3 purchases?
6. Write an algorithm for gap test. Formulate 4-digit poker test with suitable data with example. [4+6]
7. Define pseudo random numbers. The following numbers have been generated 0.44, 0.19, 0.88, 0.27, 0.55, 0.13, 0.63, 0.74, 0.11 and 0.33. Use the Kolmogorov-Smirnov test with $\alpha = 0.05$ to determine, if the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected. (Note that the critical value of D for $\alpha = 0.05$ and $N = 10$ is 0.410. [2+6]
8. Explain the iterative process of calibrating a model with example. [5]
9. How can you use estimation methods in an analysis of simulation output? Explain with example. [5]
10. Explain with example of simulation in JAVA with single server queue model. [6]
11. Explain with CPU simulation by sketching a simulation model of computer system. [6]

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2070 Bhadra

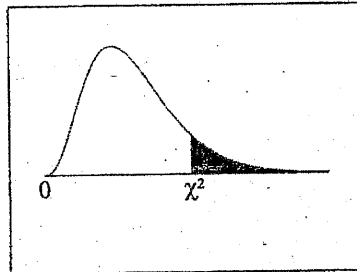
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Simulation and Modeling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary chart is attached herewith.
- ✓ Scientific calculator is allowed.
- ✓ Assume suitable data if necessary.

1. Define modeling and simulation. Explain steps involved in simulation study. [2+6]
2. What is dynamic mathematical model? Explain with examples. [6]
3. a) Explain significance of differential equation in the context of continuous system simulation. [3]
b) Develop an analog computer model of the liver and explain it. [7]
4. Mention the characteristics of queuing system. Explain the Kendall's notation in queuing systems. What is the meaning of M/D/6/10/FIFO in queuing system? [2.5+5+2.5]
5. Explain Markov Chain with an appropriate example. [6]
6. a) What is a random number? What are the problems associated with generating pseudo random numbers. [8]
b) A set of 10,000 4-digit random values have been generated. An observation shows than 5065 values have all different digits, 2000 have 2 of a kind digits, 760 have 3 of a kind, 1500 have 2 pairs and 675 have all same digits. Test these values for randomness using Poker test (Use $\alpha = 0.05$). [7]
7. Explain Naylor and Finger's steps used in validation in brief. [5]
8. What is initial bias? What is the approach for elimination of initial bias? [5]
9. Explain the at least 5 GPSS block diagram symbols with example. [6]
10. Write short notes on: (any three) [3×3]
 - a) Calibration of a model
 - b) Application of queuing system
 - c) Convolution in random number
 - d) CPU simulation

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_{\alpha}$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

Subject: - Simulation and Modeling (CT753)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary chart is attached herewith.
- ✓ Scientific calculator is allowed.
- ✓ Assume suitable data if necessary.

1. What is simulation? Explain with various steps of simulation process. [8]
2. Differentiate between physical and Mathematical Models with proper examples. [6]
3. What are the major difference between analog computer and analog methods? Design an analog computer model of the liver and explain it. [4+6]
4. What is a queueing system? List the basic characteristics of a queueing system. Explain role of Queueing systems in simulation study. Explain kendall notation with example. [2+2+2+4]
5. Explain Markov Chains? Given that chance of a Nokia user to buy Nokia at next purchase is 80% and that his next purchase will be Samsung is 20% and chance of a Samsung user to buy Samsung at next purchase is 85% and chance that his next purchase will be Nokia is 15%. What is the probability to buy Samsung after two purchase of a current Nokia user? [6]

6. a) Define random variables. Explain properties of Random variables. [2+3]

- b) A set of 100 random numbers have been generated as below: [6]

0.23 0.30 0.07 0.39 0.43 0.47 0.66 0.19 0.49 0.37 0.53
 0.80 0.56 0.10 0.28 1.00 0.23 0.04 0.93 0.25 0.90 0.24
 0.88 0.75 0.54 0.84 0.42 0.68 0.12 0.68 0.16 0.72 0.93
 0.14 0.71 0.23 0.76 0.96 0.89 0.82 0.99 0.42 0.22 0.77
 0.36 0.95 0.35 0.14 0.89 0.26 0.99 0.78 0.23 0.75 0.67
 0.34 0.04 0.95 0.41 0.89 0.64 0.88 0.92 0.62 0.84 0.36
 0.88 0.32 0.86 0.24 0.42 0.54 0.35 0.60 0.88 0.84 0.15
 0.86 0.99 0.63 0.56 0.16 0.53 0.86 0.69 0.74 0.70 0.38
 0.48 0.67 0.54 0.97 0.50 0.09 0.20 0.72 0.27 0.72 0.96

Test these values for uniform distribution using Chi Square Test (Use $\alpha=0.05$)

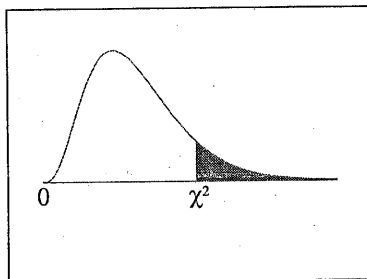
- c) A sequence of 1000 four digit numbers has been generated and analysis indicates the following combinations and frequencies: [7]

Combination (i)	Observed Frequency (O_i)
Four different digits	540
One pair	380
Two pairs	54
Three like digits	25
Four like digits	1
	1000

Based on poker test check whether the numbers are independent. Use $\alpha=0.05$ and $\chi^2 = 9.49$

7. Explain the iterative process of calibration of model with example. [5]
8. Explain role of elimination of initial bias in analysis of simulation output. [5]
9. Explain GPSS model for a general scenario of a manufacturing shop with conditional transfer. [6]
10. Explain with high level computer simulations by sketching a simulation model of computer system that services request from the World Wide Web (WWW) [6]

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_{\alpha}$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169