

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. 7
[2+6]
2. Explain static mathematical model with suitable example. [6] 3
3. What is analog computer; explain with its pros and cons. Explain the analog computer model for liver with necessary figures. [4+6] 9
4. What are the characteristics of queuing system? Discuss any one practical application of queuing system. [5+5] 7
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? 4
[2+4] -----
6. What are the properties of random numbers? Explain the steps of Gap test algorithm with example. 6
[4+6]
7. A sequence of 10,000 five digital numbers has been generated and analysis indicates the following combinations and frequencies. [8] 6

Combinations (i)	Observed Frequency (O _i)
All different	3400
One pair	4500
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

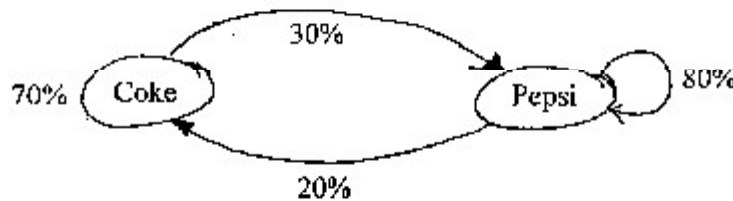
8. What is calibration and validation of models? Explain with practical example. [5] 3
9. Define initial Bias. Explain the methods for the elimination of initial bias. [5] 3
10. Explain in brief the simulation in JAVA with example. [6] 4
11. Explain the different level of abstraction for the simulation of computer system. [6] 4

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]

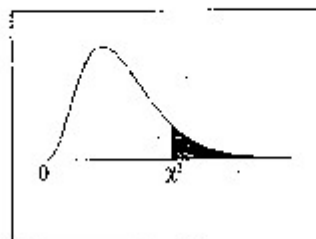
Exam.		Regular	
Level	B/E	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

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	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.800}$	$\chi^2_{.700}$	$\chi^2_{.600}$	$\chi^2_{.500}$	$\chi^2_{.400}$	$\chi^2_{.300}$
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	0.054	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	15.088	16.750	
6	0.676	0.872	1.237	1.535	2.204	10.545	12.592	14.449	16.812	18.548	
7	0.989	1.249	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	24.726	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	19.813	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	7.581	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	8.250	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	14.846	32.007	35.172	38.070	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	13.841	15.379	17.292	35.563	38.885	41.923	45.642	48.290	
27	11.808	12.879	14.573	16.161	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	17.705	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	20.709	22.164	24.433	26.009	29.651	61.805	65.758	69.342	73.361	77.070	
50	27.991	29.707	32.357	34.764	37.689	68.167	72.505	76.154	80.154	84.000	
60	35.534	37.485	40.482	43.188	46.156	74.207	79.082	83.298	87.379	91.502	
70	43.575	45.442	48.758	51.739	55.329	81.274	86.551	90.923	95.425	100.215	
80	51.172	53.540	57.153	60.591	64.278	88.379	94.379	99.329	104.210	109.321	
90	59.196	61.754	65.647	69.126	73.201	95.929	102.215	107.567	112.329	117.579	
100	67.328	70.065	74.202	77.929	81.330	103.566	110.424	115.991	121.321	126.660	

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

Subject: - Simulation and Modeling (EG778CT)

- ✓ 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 static mathematical models and dynamic mathematical models with example. What are the main differences between them? (10)
2. What is queuing system? How it is useful for simulation? Explain the different types of queuing system with example. (2+2+6)
3. Explain Markov chains with example and its applications. (10)
4. Explain the digital analog simulator. Design the analog computer model of the liver and explain it. (4+8)
5. What are the two statistical properties of Random number? Explain the gap test algorithm with example. (2+8)
6. A sequence of 1000 four digit numbers has been generated and analysis indicates the following combinations with frequencies:

Combination (i)	Observed Frequency(O_i)
Four different digits	570
One pair	380
Two pairs	34
Three like digits	15
Four like digits	1
	1000

Based on poker test check whether the numbers are independent. Use $\alpha=0.10$ and $N=4$ is 7.78 (8)

7. Write different types of simulation output analysis. In the case of infinite population which output analysis method is applicable. Why? Explain. (4+6)
8. Define the succession of events. Design a telephone system simulation model using GPSS symbols and explain in brief. (2+8)

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

Subject: - Simulation and Modeling

- ✓ 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 table is attached herewith.
- ✓ Assume suitable data if necessary.

1. Define simulation and modeling. Explain dynamic mathematical modeling with an example. [2+6]
2. What is a distributed lag model? Explain with an example. [8]
3. What is Markov chain? Explain an application of Markov chain. [8]
4. What is a random number? Explain linear congruential method for generating random numbers with an example. [4+4]
5. Given below the sequence of 100 random numbers. Use chi-square test with $\alpha = 0.05$ to check the number for uniform distribution and serial auto correlation. [12]

09	05	92	15	10	90	23	15	84	27	20	77	35	25	72	44
30	65	43	35	60	56	40	55	63	45	47	47	42	30	57	70
66	30	91	65	24	99	70	18	8	76	13	14	80	05	72	36
21	85	96	28	90	35	94	85	40	07	78	49	10	72	56	15
63	66	20	60	70	23	58	71	30	43	87	39	49	99	40	36
98	45	30	09	50	24	14	55	18	07	92	87	64	53	22	76
35	42	11	29												

6. Explain a replication of runs in an analysis of simulation output with an example. [8]
7. Explain the significance of elimination of initial bias in modeling with an example. [8]
8. What is a GPSS? List some of the common block diagram symbols used in GPSS. [2-6]
9. Explain a GPSS simulation model of a supermarket. [12]

TABLE A-2: Area in Right tail of a Chi-square Distribution.

Degrees of freedom	.20	.10	.05	.02	.01
1	1.642	2.706	3.841	5.412	6.635
2	3.219	4.605	5.991	7.879	9.210
3	4.642	6.251	7.815	9.348	11.345
4	5.989	7.779	9.488	11.668	13.277
5	7.289	9.236	11.070	13.288	15.087
6	8.558	10.645	12.592	15.033	16.812
7	9.803	12.017	14.067	16.812	18.475
8	11.030	13.362	15.507	18.475	20.090
9	12.242	14.684	16.919	19.679	21.666
10	13.442	15.987	18.307	21.161	23.209
11	14.631	17.275	19.675	22.618	24.725
12	15.812	18.549	21.026	24.054	26.217
13	16.985	19.812	22.362	25.472	27.688
14	18.151	21.064	23.685	26.871	29.141
15	19.311	22.307	24.996	28.259	30.578
16	20.465	23.542	26.296	29.633	32.000
17	21.613	24.769	27.587	30.995	33.409
18	22.760	25.989	28.869	32.346	34.805
19	23.900	27.204	30.144	33.687	36.191
20	25.018	28.412	31.410	35.020	37.566
21	26.171	29.615	32.671	36.343	39.932
22	27.301	30.813	33.924	37.659	40.289
23	28.429	32.007	35.172	38.968	41.638
24	29.553	33.196	36.415	40.270	42.980
25	30.675	34.382	37.652	41.566	44.314
26	31.795	35.563	38.885	42.856	45.642
27	32.912	36.741	40.113	44.140	46.963
28	34.027	37.916	41.337	45.419	48.278
29	35.139	39.087	42.557	46.693	49.588
30	36.250	40.256	43.773	47.962	50.892

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

Subject: - Simulation and Modeling

- ✓ 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 system modeling? Differentiate between static mathematical model and dynamic mathematical model with example. (3+7)
2. Define Markov Chains. Explain the key features and applications of Markov Chains. (4+6)
3. Explain the analog method with example of automobile suspension problem. (10)
4. What are the components of a queuing system? How can you measure of system performance of queuing system? Explain. (4+6)
5. Explain the gap test and its algorithm with example. (10)
6. Explain the pseudo random numbers and its applications. The following numbers have been generated 0.54, 0.73, 0.98, 0.11, 0.29, 0.23, 0.65, 0.84 and 0.37. 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 $N=9$ is 0.432. (4+6)
7. Why an analysis of simulation output is important? Explain the elimination of initial bias with example. (2+8)
8. Design the manufacturing shop model using GPSS and explain it. (10)

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

Subject: - Simulation and Modeling

- ✓ 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. What are the various steps in simulation study? Explain. (2+6)
2. Explain the Markov chains with example and its applications. (8)
3. What are the characteristics of queuing systems? Explain the Kendall notation for queuing systems. Define the meaning of D/M/1/LIFO/8/40. (4+6+2)
4. Mention the properties of random numbers. Explain the methods of generating pseudo random numbers. (4+8)
5. State the various test for random numbers and explain briefly any one of uniformity test method. (4+6)
6. A sequence of 1000 four-digit numbers has been generated and an analysis indicates the following combinations and frequencies.

Combinations i	Observed Frequency, O_i
Four Different digits	540
One pair	320
Two pairs	70
Three like digit	50
Four like digit	20
	1000

Based on the poker test, test these numbers are independent. Use $\alpha=0.05$. (Note: that the critical value, $\alpha=0.05$ and $N=4$ is 9.49). (8)

7. Explain the estimation method with example. Where we can apply this method? (3+3)
8. Explain the discrete system's modeling and simulation with GPSS. Explain the telephone system in GPSS model. (4+8)

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

Subject: - Simulation and Modeling

- ✓ 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 do you mean by simulation and modeling? Explain the types of models. [4+4]
2. Explain the static physical model, dynamic physical model and compare them. [8]
3. Explain the Markov chains and its application with example. [8]
4. What do you mean by distributed lag models in system simulation? Explain with example. [8]
5. What are the properties of random numbers? Explain the algorithm of Gap Test. [3+5]
6. What do you mean by digital-analog simulators? Explain the analog methods with example. [4+6]
7. Why poker test is used? Develop the poker test for four digit numbers. [4+6]
8. How can you use simulation run statistics in an analysis of simulation output? [8]
9. What do you mean by GPSS? Explain the simulation of telephone system. [4+8]

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

Subject: - Simulation and Modeling

- ✓ 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 do you mean by system modeling? Explain the advantages and disadvantages of simulation. [4+4]
2. Explain the static mathematical model, dynamic mathematical model and compare them. [8]
3. What do you mean by calibration and validation of model? Explain the iterative process of calibrating of model with example. [4+5]
4. Write down the characteristics of queueing system. Explain the queueing notation with example. [4+5]
5. Why random numbers are used in simulation? Explain the random number generation method with example. [3+5]
6. What do you mean by continuous system model? Design the analog computer model of liver with example. [3+5]
7. Why poker test is used? Develop the poker test for five-digit numbers. [4+6]
8. How can you use replication of runs in an analysis of simulation output? Explain. [8]
9. What do you mean by GPSS program? Explain the simulation of manufacturing shop. [4+8]
