Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2023

Course: Modeling & Simulation **Semester: IV**

Program: B.Tech CSE-IV-BData-BAO-CCVT-CSF-DevOps-OSSOS- AIML-IoT (Honors)

Time : 03 hrs.

Course Code: CSEG2037P **Max. Marks: 100**

Instructions: All Questions are compulsory. Please attempt the questions in serial order. Kolmogorov Smirnov Table is given at the end.

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	List out the suitable examples for "When simulation is the appropriate tool" and "When simulation is the not appropriate."	**4**	**CO1**
Q2	Define DFA. Design a DFA with proper description for L(M) = {x | x is a string of (zero or more) a's, b's and c's such that x does *not* contain the substring *aa*}.	**4**	**CO2**
Q3	How you can use parallel and distributed simulation for your project. Explain with a case study.	**4**	**CO3**
Q4	The daily demand for a product is found to follow the distribution as *Demand* | *Probability* 10 | 0.25 11 | 0.35 12 | 0.30 13 | 0.10 Determine the total demand for the next 10 days.	**4**	**CO3**
Q5	**How you can analyze the simulation results using** **a.** Tables, **b.** Graphs, **c.** Multidimensional Visualization and d. MS Excel	**4**	**CO1**

SECTION B

(4Qx10M= 40 Marks)

Q6	Draw and explain agent based simulation architectural diagram with its core components. Also list its advantages and disadvantages.	**10**	**CO3**
Q7	Differentiate horizontal and vertical partitioning with suitable examples.	**10**	**CO3**

<table>
<tr><td>Q8</td><td>List out the steps used in Kolmogorov Smirnov test.
The sequence of numbers 0.54, 0.73, 0.98, 0.1 1, and 0.68 has been generated. Use the Kolmogornv-Smirnov test with a= 0.05 to learn whether the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be accepted/ rejected.</td><td>3+7</td><td>CO4</td></tr>
<tr><td>Q9</td><td>How to perform the calibration and validation on simulation models. Justify the behavior of Face Validity, Model assumption and I/O transformation with suitable examples.</td><td>3+7</td><td>CO4</td></tr>
<tr><td colspan="4">SECTION-C
(2Qx20M=40 Marks)</td></tr>
<tr><td>Q10</td><td>a) Derive the random inverse variate for given pdf
$$f(x)=\begin{cases}\lambda e^{-\lambda x}, & x\geq 0\\ 0, & x<0\end{cases}$$
b) Generate 3 Poisson variates with mean 0.2, and then get a sequence of 5 random numbers.
OR
a) List out the steps used in Kolmogorov Smirnov test. Use the mixed congruential method to generate a sequence of 5 two-digit random numbers with X_0 = 37, a=7, c =29, and m= 100.
b) Write a computer program to generate exponential random variates for a given mean value. Generate 1000 values and verify the variates generated using chi-square test.</td><td>10 + 10</td><td>CO4</td></tr>
<tr><td>Q11</td><td>c) Consider a computer technical support center where personnel take calls and provide services. The time between calls ranges from 1 to 4 minutes, with distribution as shown in Table 1.

Table 1: Interarrival distribution of calls for technical support.
<table>
<tr><th>Time between Arrivals (Minutes)</th><th>Probability</th><th>Cumulative Probability</th><th>Random-Digit Assignment</th></tr>
<tr><td>1</td><td>0.25</td><td>0.25</td><td>01–25</td></tr>
<tr><td>2</td><td>0.40</td><td>0.65</td><td>26–65</td></tr>
<tr><td>3</td><td>0.20</td><td>0.85</td><td>66–85</td></tr>
<tr><td>4</td><td>0.15</td><td>1.00</td><td>86–00</td></tr>
</table>
There are two technical support persons Able and Baker. Able is more experienced and can provide service faster than Baker. The distributions of their service times are shown in Tables 2 and 3.
Table 2: Service distribution of Able
<table>
<tr><th>Service Time (Minutes)</th><th>Probability</th><th>Cumulative Probability</th><th>Random-Digit Assignment</th></tr>
<tr><td>2</td><td>0.30</td><td>0.30</td><td>01–30</td></tr>
<tr><td>3</td><td>0.28</td><td>0.58</td><td>31–58</td></tr>
<tr><td>4</td><td>0.25</td><td>0.83</td><td>59–83</td></tr>
<tr><td>5</td><td>0.17</td><td>1.00</td><td>84–00</td></tr>
</table></td><td>15+5</td><td>CO2</td></tr>
</table>

Table 3. Service distribution of Baker

Service Time (Minutes)	Probability	Cumulative Probability	Random-Digit Assignment
3	0.35	0.35	01–35
4	0.25	0.60	36–60
5	0.20	0.80	61–80
6	0.20	1.00	81–00

A simplifying rule is that Able gets the call if both technical support people are idle. Able is more senior than Baker.
Find how well the current arrangement is working to estimate the system measures of performance, a simulation of the first 100 caller is made.

b) Use the linear congruential method to generate a sequence of random numbers with X_0 = 27, a= 17, c=43, and m = 100.

Table A.8 Kolmogorov–Smirnov Critical Values

Degrees of Freedom (N)	$D_{0.10}$	$D_{0.05}$	$D_{0.01}$
1	0.950	0.975	0.995
2	0.776	0.842	0.929
3	0.642	0.708	0.828
4	0.564	0.624	0.733
5	0.510	0.565	0.669
6	0.470	0.521	0.618
7	0.438	0.486	0.577
8	0.411	0.457	0.543
9	0.388	0.432	0.514
10	0.368	0.410	0.490
11	0.352	0.391	0.468
12	0.338	0.375	0.450
13	0.325	0.361	0.433
14	0.314	0.349	0.418
15	0.304	0.338	0.404
16	0.295	0.328	0.392
17	0.286	0.318	0.381
18	0.278	0.309	0.371
19	0.272	0.301	0.363
20	0.264	0.294	0.356
25	0.24	0.27	0.32
30	0.22	0.24	0.29
35	0.21	0.23	0.27
Over 35	$\frac{1.22}{\sqrt{N}}$	$\frac{1.36}{\sqrt{N}}$	$\frac{1.63}{\sqrt{N}}$