B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Industrial Engineering & Management **Duration: 3 hrs.**
Course Code: 22IM6PCSMA **Max Marks: 100**
Course: Simulation Modelling and Analysis

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Statistical tables permitted.

			UNIT – I	CO	PO	Marks
1	a)		List and Explain with an example principles used in Modeling	CO1	PO1	**10**
	b)		Name entities, attributes, activities, events, and state variables for the following systems: (i) University library (ii) Bank (iii) Call center (iv) Hospital blood bank (v) Departmental store	CO1	PO1	**10**
			OR			
2	a)		List and explain the necessary steps involved in a simulation with a flow chart	CO1	PO1	**10**
	b)		Suppose the duration of activities are non-deterministic with the following probability distribution: Simulate the duration of the project for 5 times and estimate the chances of various critical paths. What is the average duration of the project?	CO2	PO1	**10**
			UNIT – II			
3	a)		What is Time advance algorithm? Briefly Explain the steps involved in the algorithm.	CO1	PO1	**10**
	b)		The sequence of numbers 0.45, 0.37, 0.89, 0.11 and 0.86 has been generated. Use the Kolmogorov-Smirnov test with $\alpha = 10\%$ to learn whether the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected.	CO3	PO2	**10**

The table referenced in question 2b:

Activity	Days	Probability
1-2	1	0.2
	4	0.5
	8	0.3
1-3	2	0.3
	4	0.5
	7	0.2
2-4	2	0.3
	4	0.3
	6	0.4
1-4	3	0.3
	6	0.4
	8	0.3
4-5	2	0.2
	2	0.2
	6	0.6

			OR		CO3	PO2	**10**
4	a)		Based on the Runs above and below the mean, determine whether the following sequence of 40 numbers is such that the hypothesis of independence can be rejected where α = 10%		CO3	PO2	**10**

0.382	0.101	0.596	0.99	0.495	0.958	0.014	0.407	0.863	0.198
0.245	0.045	0.032	0.495	0.220	0.017	0.285	0.343	0.554	0.926
0.372	0.356	0.910	0.466	0.426	0.304	0.976	0.807	0.991	0.627
0.952	0.053	0.705	0.817	0.973	0.466	0.300	0.750	0.351	0.797

				CO	PO	Marks
	b)	Use the linear congruential method to generate a sequence of three two digit random integers. Let $x_0 = 27$, $a = 8$, $c = 47$ and $m = 100$		CO2	PO1	**06**
	c)	Explain pseudo random numbers and also list necessary properties required for generating pseudo random numbers		CO1	PO1	**04**

UNIT - III

				CO	PO	Marks
5	a)	Shop floor manager wants to develop a model to help scheduling of jobs in the shop floor. He has evaluated the completion times for all the different types of jobs. For one particular job, the times to completion can be represented by the following distribution function:		CO3	PO2	**10**

$$f(x) = \begin{cases} \dfrac{1}{4}, & 1 \le x \le 3 \\[2mm] \dfrac{1}{2}, & 3 \le x \le 4 \\[2mm] 0, & Otherwise \end{cases}$$

As an analyst develop a process generator for this distribution using the inverse transformation method.

				CO	PO	Marks
	b)	Derive step by step procedure to generate random variates by method of inverse transformation for exponential distribution and also determine 5 values of X when mean value = 1.2.		CO2	PO1	**10**
			OR				
6	a)	Times to failure for an ATM have been found to be randomly distributed with a weibull distribution with scale parameter = 10, shape parameter = 2 and location parameter = 0. Generate Five values of X for the weibull distribution. Choose random numbers : 0.25, 0.68, 0.78, 0.10 and 0.01		CO2	PO1	**07**
	b)	Regular maintenance of a production routine has been found to vary and has been modeled as a normally distributed random variable with mean 33 minutes and variance 4 minutes2. Generate five random maintenance times from the given distribution		CO2	PO1	**07**
	c)	Derive step by step procedure to generate random variates by method of inverse transformation for Uniform distribution		CO2	PO1	**06**

			UNIT – IV			
7	a)		Records pertaining to monthly customer complaints for an XYZ product were studied by customer care department. The values for the past 100 months were as follows:	CO3	PO2	**14**

Customer complaints (X_i)	0	1	2	3	4	5	6	7	8	9	10	11
frequency	12	10	19	17	X	8	7	5	5	3	3	1

			Use Chi- square test for hypothesis that the data pattern follows Poisson distribution, assume level of significance = 5%.			
	b)		Explain the following with respect to simulation models: (i) Verification (ii) Validation and (iii) Calibration	CO1	PO1	**06**
			OR			
8	a)		Briefly explain Naylor and Finger three – step approach for validation process	CO1	PO1	**06**
	b)		10 inter arrival times (minutes) are collected over the following 100-minute interval.	CO2	PO1	**10**

0.54	0.53	2.44	2.04	3.0	0.3	2.54	0.52	1.89	1.53

			Test whether the data follows exponentially distributed? assume level of significance = 5%.			
	c)		Explain the necessary steps involved in simulation when models does not have necessary data.	CO1	PO1	**04**
			UNIT – V			
9	a)		Explain the role of Simulation in Manufacturing systems. Also list objectives of simulating manufacturing systems.	CO2	PO2	**10**
	b)		Write short notes on: (i) Constrained transporters (ii) Common Issues in manufacturing system simulations	CO1	PO1	**10**
			OR			
10	a)		Explain the need of Simulation modeling & Analysis in Manufacturing systems.	CO1	PO1	**10**
	b)		Write short notes on: (i) Performance Measures for manufacturing systems (ii) Types of Material Handling equipments	CO1	PO1	**10**

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