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Register Number:……..…

M.E/M.TECH DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Second Semester

INDUSTRIAL ENGINEERING

P18IET2008: System Modeling and Simulation

COURSE OUTCOMES

CO1: Illustrate the concept of simulation, types of simulation and types of models.

CO2: Generate random variates and random numbers using distributions.

CO3: Manipulate the tests on random numbers to check the uniformity.

CO4: Model the system using GPSS.

CO5: Develop simulation models for queuing systems, production and inventory models.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Select the correct sequence of business processing (1) A New Policy for the Service Request Assignment Problem (2) Process Execution Monitoring and Adjustment Schemes (3) In-Store Merchandizing of Retail Stores (4)Sales Forecasting for Retail Small Stores — CO1 [K_1]

   a) 1-2-3-4 b) 2-4-3-1

   c) 1-3-2-4 d) 4-3-2-1

2. The algorithm sequence are (1) Return (2) Set formulation (3) Evaluate each individual generator (4) Select seed X1,0 in the range for the first generator — CO2 [K_1]

   a) 1-2-3-4 b) 2-4-3-1

   c) 1-3-2-4 d) 4-3-2-1

3. The uniform distribution sequence are (1) either agrees or not (2) select cumulative distribution function (3) Solving for X in terms of R yields $X = a + (b - a)R$ (4) Set $F(X) = (X - a)/(b - a) = R$ — CO3 [K_1]

   a) 1-2-3-4 b) 2-4-3-1

   c) 1-3-2-4 d) 4-3-2-1

4. Matching the list I with list II CO3 [K_2]

List I	List II
A. banking	i. riders
B. rapid rail	ii. messages
C. production	iii. customers
D. communications	iv. breakdown

a) A-iii, B-i, C-iv, D-ii b) A-i, B-iii, C-iv, D-i

c) A-ii, B-i, C-iv, D-iii d) A-iii, B-ii, C-i, D-iv

5. Matching the list I with list II CO4 [K_2]

List I	List II
A. combine two or more multiplicative congruential generators	i. dependence between numbers
B. autocorrelation	ii. longer period
C. exponential distribution	iii. time to failure
D. Weibull distribution	iv. probability density function

a) A-iii, B-i, C-iv, D-ii b) A-i, B-iii, C-iv, D-i

c) A-ii, B-i, C-iv, D-iii d) A-iii, B-ii, C-i, D-iv

6. Matching the list I with list II CO5 [K_2]

List I	List II
A. response-time distribution	i. observations
B. discrete random variable	ii. independent
C. frequency test	iii. finite
D. null hypothesis	iv. Kolmogorov–Smirnov

a) A-iii, B-i, C-iv, D-ii b) A-i, B-iii, C-iv, D-i

c) A-ii, B-i, C-iv, D-iii d) A-iii, B-ii, C-i, D-iv

7. Assertion (A): if system behavior is too complex or cannot be defined, simulation is not appropriate. CO1 [K_2]

Reason (R): Human behavior is sometimes extremely complex to model.

a) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion

b) Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A)

c) Assertion (A) is true and Reason (R) is false
d) Assertion (A) is false and Reason (R) is true

8. Assertion (A): If the method is known, the set of random numbers can be repeated. CO2 [K_2]

Reason (R): Then an argument can be made that the numbers are not truly random.

a) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion
b) Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A)
c) Assertion (A) is true and Reason (R) is false
d) Assertion (A) is false and Reason (R) is true

9. A system is defined as a group of objects that are joined together in some ……..toward the accomplishment of some purpose. CO4 [K_1]

a) interdependence
b) irregular interaction
c) irregular interaction or interdependence
d) regular interaction or interdependence

10. Random numbers have the statistical property/properties of …… CO5 [K_1]

a) uniformity alone
b) independence only
c) uniformity and dependence
d) uniformity and independence

PART B (10 x 2 = 20 Marks)

11. List some advantages of simulation. CO1 [K_1]
12. Define few components of a system. CO1 [K_1]
13. What is initial seed for a linear congruential random-number generator? CO2 [K_2]
14. What is table-lookup generation? CO2 [K_2]
15. Describe a procedure to physically generate random numbers on the interval [0, 1] with 2-digit accuracy. CO3 [K_4]
16. Lead times have been found to be exponentially distributed with mean 3.7 days. How to generate random lead times from this distribution? CO3 [K_4]
17. When the model based on Poisson distribution is to be selected? CO5 [K_2]
18. Brief the test used for large sample sizes and for both discrete and continuous distributional data. CO4 [K_2]
19. How to characterize an arrival process for infinite-population models? CO5 [K_2]
20. List the uses of General Purpose Simulation System. CO4 [K_1]

PART C (6 x 5 = 30 Marks)

21. Discuss the purposes of simulation. CO1 [K_2]

22. Discuss few important considerations in pseudorandom numbers generation. CO2 [K_2]

23. Explain the frequency test procedure in details. CO2 [K_3]

24. Develop a random-variate generator for a random variable X with the pdf CO3 [K_4]

$$f(x) = \begin{cases} e^{2x}, & - \quad < x \quad 0 \\ e^{-2x}, & 0 < x < \end{cases}$$

25. Describe the four steps in the development of a useful model of input data. CO4 [K_3]

26. Consider a discount warehouse where customers may either serve themselves or wait for one of three clerks, then finally leave after paying a single cashier. The subsystem, consisting of queue 2 and service center 2 with 3 clerks. Draw the flow diagram for the queuing system and discuss. CO5 [K_4]

Answer any FOUR Questions
PART D (4 x 10 = 40 Marks)

27. Select any one system and list its system components, then explain how the entity, attribute, activity, event and state variable will be controlled in details. CO1 [K_4]

28. Use the linear congruential method to generate a sequence of random numbers with $X_0 = 27$, a = 17, c = 43, and m = 100. How to achieve maximal period by the proper choice of a, c, m, and X_0. CO2 [K_4]

29. Five observations of fire-crew response times (in minutes) to incoming alarms were collected. Apply the data to simulate the investigation for a possible alternative staffing and crew-scheduling policies by finding cumulative probability and fire-crew response times. CO3 [K_4]

    The data are: 2.76, 1.83, 0.80, 1.45 and 1.24.

30. Consider a physician who schedules patients every 10 minutes and who spends Si minutes with the i^{th} patient, where CO5 [K_4]

    Si = 9 minutes with probability 0.9

    Si = 12 minutes with probability 0.1

    The arrivals are deterministic but services are stochastic (or probabilistic), determine mean, variance and check the stability of number of patients in the doctor's office at time.

31. Explain the simulation methods for an arrival of k customers at server with necessary parameters. CO4 [K_3]

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