KUMARAGURU
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Register Number:……

**M.E DEGREE EXAMINATIONS: JUNE 2017**

(Regulation 2015)

Second Semester

**M.E. INDUSTRIAL ENGINEERING**

P15IET202: System Modelling and Simulation

(Use of appropriate statistical tables are permitted)

**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. Assertion (A): The results of the simulation are difficult to interpret CO1 [$K_2$]
   Reason (R): The change in the simulation output may be due to the random nature of input or changes made in the model
   a) Both A and R are Individually true and R is the correct explanation of A
   b) Both A and R are Individually true but R is not the correct explanation of A
   c) A is true but R is false
   d) A is false but R is true

2. _____ is the objective of any simulation study CO1 [$K_1$]
   a) Event
   b) Time
   c) System
   d) Entity

3. The random numbers are used to model the input to _____ models CO2 [$K_2$]
   a) Physical
   b) Stochastic
   c) Deterministic
   d) Non-stochastic

4. Match the List I with List II and select suitable choice code CO3 [$K_2$]

| List I | List II |
|---|---|
| A. Runs test | i. To study the impact of repeated numbers |
| B. Gap test | ii. To study similarity between observations with a lag |

| | |
|---|---|
| C. Poker test | iii. To study the trend in the generated random number |
| D. Autocorrelation test | iv. To study the relationship between the digits |

| | A | B | C | D |
|---|---|---|---|---|
| a) | ii | i | iii | iv |
| b) | iii | iv | ii | i |
| c) | ii | iv | iii | i |
| d) | iii | i | iv | ii |

5. Assertion (A): Pseudo random numbers can be generated using algorithms CO3 [$K_2$]
Reason (R): There may be some undetected relationship exist in the generated stream of numbers.

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

6. Events scheduled to occur at the same time is called as _____ CO4 [$K_2$]

a) Overlapping events
b) Time tied events
c) Unscheduled events
d) Blocked events

7. Transactions generated in GPSS/H simulation represents CO4 [$K_2$]

1. Server
2. Entity
3. Events
4. State of the system

a) 1,3
b) 1,4
c) 1,2
d) 2,3

8. _____ block is used in GPSS/H to model multiple servers CO4 [$K_1$]

a) STORAGE
b) GENERATE
c) LEAVE
d) ADVANCE

9. The _____ gets altered when an event occurs CO5 [$K_2$]

a) Delay time periods
b) Service time
c) State of the system
d) Waiting time

10. Sequence the events happening when customer enters the system CO5 [$K_2$]

1. Queue gets decremented once service time ends
2. Customer joins the queue wait until service begins
3. Service time begins
4. Customer departs from the system

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

## PART B (10 x 2 = 20 Marks)

| | | | |
|---|---|---|---|
| 11. | List the types of events in a system. | CO1 | [$K_2$] |
| 12. | What do you understand by the terms conditional and unconditional delay? | CO1 | [$K_2$] |
| 13. | List the impact on uniformity property on the simulation results. | CO2 | [$K_2$] |
| 14. | What are conditions to be fulfilled to get maximum cycle length in generating the random numbers using linear congruential generators? | CO2 | [$K_2$] |
| 15. | List the limitations of acceptance and rejection technique used to generate random variates. | CO3 | [$K_2$] |
| 16. | What will happen if a GPSS/H code is compiled with SIMULATE block | CO4 | [$K_2$] |
| 17. | What is the function of GENERATE block in GPSS/H model simulation? | CO4 | [$K_2$] |
| 18. | List any four names of simulation software. | CO4 | [$K_2$] |
| 19. | List the objectives of simulating an inventory system. | CO5 | [$K_2$] |
| 20. | List advantages of simulation in a shop floor environment. | CO5 | [$K_2$] |

## PART C (6 x 5 = 30 Marks)

| | | | |
|---|---|---|---|
| 21. | Discuss in detail about the differences between model verification and validation. | CO1 | [$K_3$] |
| 22. | Explain the random number generation using mid-square method and list the limitations. | CO2 | [$K_2$] |
| 23. | How to generate random variates uniformly distributed between 0.25 and 0.8. | CO2 | [$K_3$] |
| 24. | Discuss the requirements of simulation software. | CO4 | [$K_3$] |
| 25. | Discuss the syntax and functions of following GPSS/H blocks<br>1. ENTER & LEAVE<br>2. ADVANCE<br>3. SEIZE & RELEASE | CO4 | [$K_2$] |
| 26. | Customers arrive at a single server counter with an average inter-arrival time of 20 plus/minus 10 seconds. They purchase from 1 to 4 items with the following probabilities: | CO5 | [$K_3$] |

| Number of items purchased | Proabaility |
|---|---|
| 1 | 0.5 |
| 2 | 0.2 |
| 3 | 0.2 |
| 4 | 0.1 |

It takes 5 seconds to purchase each item. Develop a GPSS for model for simulating 100 customers.

**Answer any FOUR Questions**

**PART D (4 x 10 = 40 Marks)**

27. What is system and system environment? Explain the components of a system with suitable examples. CO1 [$K_2$]

28. Generate five random numbers using multiplicative congruential method with $X_0$ = 5, a = 10 and m = 64. Test these numbers using Kolmogorov-Smirnov test with significance level of 0.05 and check the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected. CO2 [$K_3$]

29. What is acceptance-rejection technique? Generate three Poisson variates with mean = 0.2. CO2 [$K_3$]

30. A sequence of 1000 four digit numbers has been generated and analysis indicates the following combinations and frequencies. Based on poker test check whether the numbers are independent. Use significance level of 0.05. CO3 [$K_3$]

| Combination (i) | Observed frequency Oi |
|---|---|
| Four different digits | 565 |
| One pair | 392 |
| Two pairs | 17 |
| Three like digits | 24 |
| Four like digits | 2 |

31. A super highway connects one large metropolitan area to another. A vehicle leaves the first city every 20±15 seconds. Twenty percent of the vehicles have 1 passenger, 30% of the vehicles have 2 passengers, 10% of the vehicles have 4 passengers. The remaining 30% of the vehicles are buses, which carry 40 people. It takes 60±10 minutes for a vehicle to travel between the metropolitan areas. How long does it take for 5000 people to arrive in the second city? CO4 [$K_3$]

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