FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

Department of Information Technology

B.E. (I.T.) (Semester VIII) (2018-2019)

Lesson Plan

Subject: Computer Simulation and Modeling Credits: 05

Syllabus:

Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC803	Computer Simulation and Modeling	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ITC803	Computer Simulation and Modeling	20	20	20	80	25	25	---	150

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1	UNIT - I Introduction to simulation	Introduction to Simulation. Simulation Examples. General Principles	**15**
2	UNIT - II Mathematical & Statistical Models in Simulation	Statistical Models in simulation. Queuing Models	**8**

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3	UNIT - III Random Numbers	Random Number Generation. Testing random numbers (Refer to Third edition) Random Variate Generation: Inverse transform technique, Direct Transformation for the Normal Distribution, Convolution Method, Acceptance-Rejection Technique (only Poisson Distribution).	**9**
4	UNIT – IV Analysis of simulation data	Input Modeling Verification, Calibration and Validation of Simulation Models Estimation of absolute performance.	**12**
5	UNIT V	Case study	
	Application	• Processor and Memory simulation • Manufacturing & Material handling	**4**

Text Books:

Discrete Event System Simulation; Third Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

Discrete Event System Simulation; Fifth Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

References:

1. System Modeling & Analysis; Averill M Law, 4th Edition TMH.
2. Principles of Modeling and Simulation; Banks C M , Sokolowski J A; Wiley
3. System Simulation ; Geoffrey Gordon ; EEE
4. System Simulation with Digital Computer; Narsing Deo, PHI

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Term work:

Laboratory work: 10 marks

Mini Simulation Project presentation: 10 marks

Attendance / Quiz: 5 marks

Suggested Practical List (If Any):

Perform simulation exercises given in the text book (third edition) using spreadsheets and/or simulation language/package

- Queue- single server, multi-server, classic case- dump truck
- Inventory – Lead time=0, lead time fixed, lead time probabilistic
- Reliability problem
- Tutorials on statistical models
- Random number generate and test
- Goodness of fit test
- Output analysis – Point estimate and Confidence Interval

Simulation: Real World Examples – can be in the field of business, transportation, medical, computing, manufacturing and material handling- Presentation to be taken.

Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.

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Course Outcomes:

CO1	Understand the meaning of simulation and its importance in business, science, engineering, industry and services.
CO2	Analyze events and inter-arrival time, arrival process, queuing strategies, resources and disposal of entities.
CO3	Perform a simulation using spreadsheets as well as simulation language/package.
CO4	Ability to generate pseudorandom numbers using the Linear Congruential Method and perform statistical tests to measure the quality of a pseudorandom number generator.
CO5	Analyze and fit the collected data to different distributions.
CO6	Identify the common applications of discrete-event system simulation.

CO-PO and CO-PSO Mapping

Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2		2					1	1		2	3	2
CO2	2	3	3	2	2				1	1		1	1	2
CO3	2	3	3	2	2				1	1		1	1	2
CO4	2	2	3	2	1							2	1	1
CO5	2	2	2	1	1							1	2	2
CO6	3	2	1	2	2		2		2	2		3	3	2

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CO Assessment tools with target.

	Direct Methods								**Indirect Methods**
	Test1	**Assig1**	**Lab Work**	**Test2**	**Assig2**	**University Theory Result**	**University Oral Result**	**MCQ**	Course Exit Survey
CO1	**25%**	**25%**	**5%**	**-**	**-**	**25%**	**20%**	**-**	**100%**
CO2	**30%**	**20%**	**40%**	**-**	**-**	**10%**		**-**	**100%**
CO3	**25%**	**10%**	**20%**			**20%**	**25%**	**-**	**100%**
CO4	**-**	**-**	**30%**	**40%**		**20%**	**10%**	**-**	**100%**
CO5	**-**	**-**	**10%**	**40%**		**25%**	**25%**	**-**	**100%**
CO6	**-**	**-**	**5%**	**15%**		**40%**	**40%**	**-**	**100%**

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Lecture Plan:

No of classes Planned:	45	**No of Classes taken:**	49	
Sr. No.	**Topic Planned**	**Planned Date**	**Actual Date**	**Delivery Mechanisms**
1.	Simulation, When Simulation is an appropriate tool, When simulation is not an appropriate tool.	01/01/2019	01/01/2019	Board
2.	Advantages and disadvantages of simulation, Areas of applications of simulation,	02/01/2019	02/01/2019	Board
3.	System and system environment, Types of Systems	03/01/2019	02/01/2019	Board
4.	Model and its types	04/01/2019	03/01/2019	Board
5.	Steps in simulation study	04/01/2019	03/01/2019	Board
6.	Single Server Queueing System	08/01/2019	08/01/2019	Board
7.	Simulation of Single Server Queueing System	09/01/2019	09/01/2019	Board
8.	Multi-Server Queueing System	10/01/2019	10/01/2019	Board
9.	(M,N) Inventory System,Lead Time Demand	11/01/2019	11/01/2019	Board
10.	Classical Inventory System	11/01/2019	11/01/2019	Board
11.	Reliability System	15/01/2019	15/01/2019	Board

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12.	Concepts in Discrete Event Simulation, Event Scheduling algorithm	16/01/2019	16/01/2019	Board
13.	World Views	17/01/2019	17/01/2019	Board
14.	Manual Simulation for Single Server Queueing System	18/01/2019	18/01/2019	Board
15.	Dump Truck Problem	22/01/2019	18/01/2019	Board
16.	Bernoulli's trials, Binomial Distribution	23/01/2019	22/01/2019	Board
17.	Geometric Distribution, Poisson Distribution	24/01/2019	23/01/2019	Board
18.	Uniform Distribution, Exponential Distribution	25/01/2019	24/01/2019	Board
19.	Erlang Distribution, Normal Distribution	29/01/2019	25/01/2019	Board
20.	Weibull Distribution, Triangular Distribution, Poisson Process	30/01/2019	30/01/2019	Board
21.	Characteristics of Queueing System, Queueing Notations	01/02/2019	01/02/2019	Board +PPT
22.	Long-run Measures of Performance of Queueing Systems	07/02/2019	07/02/2019	Board +PPT
23.	M/M/1 and M/G/1 Queueing System	08/02/2019	07/02/2019	Board + PPT
24.	M/G/C Queueing System	12/02/2019	08/02/2019	Board + PPT
25.	Properties of random numbers, Techniques for generating pseudo random numbers	20/02/2019	08/02/2019	Board
26.	Kolmogorov Smirnov Test, chi-square Test for uniformity	21/02/2019	20/02/2019	Board

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Department of Information Technology

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27.	Runs Test for Independence	22/02/2019	20/02/2019	Board
28.	Autocorrelation Test, Gap Test	26/02/2019	21/02/2019	Board
29.	Poker Test	27/02/2019	21/02/2019	Board
30.	Inverse Transform Technique for random variate generation	28/02/2019	21/02/2019	Board
31.	Inverse Transform Technique for Bernoulli and Empirical Discrete Distribution	01/03/2019	22/02/2019	Board
32.	Inverse Transform Technique for Uniform and Geometric Distribution	05/03/2019	22/02/2019	Board
33.	Direct Transformation for normal and lognormal distribution, Convolution method	06/03/2019	22/02/2019	Board
34.	Acceptance-Rejection Technique	07/03/2019	26/02/2019	Board
35.	Steps in Input Modeling	08/03/2019	07/03/2019	Board + PPT
36.	Goodness of Fit Tests	12/03/2019	08/03/2019	Board
37.	Covariance and Correlation	13/03/2019	12/03/2019	Board
38.	Multivariate and Time Series Input Models	14/03/2019	12/03/2019	Board
39.	Verification and Validation of Simulation Models	19/03/2019	13/03/2019	PPT
40.	Types of simulation with respect to output analysis, Point and Interval Estimation	20/03/2019	14/03/2019	PPT
41.	Output Analysis of Terminating Simulations	22/03/2019	14/03/2019	PPT

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Department of Information Technology

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Lesson Plan

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42.	Output Analysis of Steady State Simulations	26/03/2019	19/03/2019	PPT
43.	Batch Means for Interval Estimation and Confidence Intervals for Quantiles	27/03/2019	20/03/2019	Board + PPT
44.	Simulation of Manufacturing and Material Handling Systems	28/03/2019	22/03/2019	PPT
45.	Simulation of Computer System	29/03/2019	26/03/2019	PPT
46.	Revision	27/03/2019		
47.	Revision	28/03/2019		
48.	Revision	29/03/2019		
49.	Revision	02/01/2019		

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Lab Plan

Sr. No	**LIST OF EXPERIMENTS**		Batch B
1	Simulation of Single Server Queueing System in Excel Spreadsheet.	CO2	18/01/19
2.	Simulation of Multi-Server Queueing System in Excel Spreadsheet.	CO2	25/01/19
3.	Simulation of (M,N) Inventory System in Excel Spreadsheet.	CO2	01/02/19
4.	Simulation of Newspaper Seller Problem in Excel Spreadsheet.	CO2	01/02/19
5.	Implementation of Binomial Distribution in C/Java/Python.	CO3	08/02/19
6.	Implementation of Poisson Distribution in C/Java/Python.	CO3	22/02/19
7.	Implementation of Linear Congruential Method in C/Java/Python.	CO4	01/03/19
8.	Implementation of Kolmogorov Smirnov Test in C/Java/Python.	CO4	01/03/19
9.	Implementation of Poker Test in C/Java/Python	CO4	08/03/19
10.	Implementation of Covariance and Correlation in C/Java/Python.	CO5	22/03/19
11.	Case Study: Batch A: Simulation of Manufacturing System Batch B: Simulation of Computer System Batch C: ARENA Simulation Software Batch D: NetSim Simulation Software	CO1 CO6	29/03/19

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Assignment Plan

Assignment No. 1

<table>
<tr><td>1</td><td>State when simulation is appropriate and when it is not.</td><td>CO1</td></tr>
<tr><td>2</td><td>Name several entities, attributes, activities, events, and state variables for the following systems:
i. A cafeteria
ii. A Laundromat
iii. A Bank</td><td>CO1</td></tr>
<tr><td>3</td><td>A stationery store has only one copier machine. Students arrive at this store at random from 1 to 10 minutes apart to Xerox notes. Each possible value of interarrival time has the same probability of occurrence. The service times vary from 1 to 6 minutes with the probabilities shown in Table 1.
<table>
<tr><td>Service Time (Minutes)</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Probability</td><td>0.05</td><td>0.10</td><td>0.20</td><td>0.30</td><td>0.25</td><td>0.10</td></tr>
</table>
Table 1: Service-Time Distribution
Develop the simulation table and analysis for 10 customers. Random Digits for Interarrivaltime and service time of 10 customers are given in Table 2.
<table>
<tr><td>Customer</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Random Digits for Interarrival Time</td><td>--</td><td>913</td><td>727</td><td>015</td><td>948</td><td>309</td><td>922</td><td>753</td><td>235</td><td>302</td></tr>
<tr><td>Random Digits for Service Time</td><td>84</td><td>10</td><td>74</td><td>53</td><td>17</td><td>79</td><td>91</td><td>67</td><td>89</td><td>38</td></tr>
</table>
Table 2: Random Digits</td><td>CO2</td></tr>
<tr><td>4</td><td>Distinguish between :-
i. Continuous and Discrete system
ii. Activity and Delay
iii. Continuous and Discrete Random Variable</td><td>CO2</td></tr>
<tr><td>5</td><td>Suppose that the life of an industrial lamp, in thousands of hours, is exponentially distributed with failure rate $\lambda = 1/3$ (one failure every 3000 hours, on the average). What is the probability that the lamp will last between 2000 and 3000 hours?</td><td>CO3</td></tr>
<tr><td>6</td><td>Lane Braintwain receives, on the average, four phone calls a night (Poisson distributed). What is the probability that tomorrow night the number of phone calls received will exceed the average by more than one standard deviation?</td><td>CO3</td></tr>
</table>

Date of Display: 28/01/2019

Date of Submission: 08/02/2019

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Assignment No. 2

1	Derive the conservation equation and state its significance.	CO4
2	The sequence of numbers 0.54, 0.73, 0.98, 0.11, and 0.68 has been generated. 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. Use $D_{0.05,5} = 0.565$.	CO4
3	Explain Direct Transformation method for random variate generation using Normal and Lognormal distribution.	CO5
4	The following data were available for the past 10 years on demand and lead time. **Lead time**: 6.5, 4.3, 6.9, 6.0, 6.9, 6.9, 5.8, 7.3, 4.5, 6.3 **Demand**: 103, 83, 116, 97, 112, 104, 106, 109, 92, 96 Estimate correlation and covariance.	CO5
5	Suggest a distribution for the following process in the computer assembly shop: (i) Number of defective chips found in a lot of n chips. (ii) Number of computer chips that we must inspect to find 4 defective chips. (iii) Time to assemble a computer which is the sum of the times required for each assembly operation. (iv) Time to failure for a disk drive. (v) If the minimum, most-likely, and maximum time required to test a product is known.	CO6
6	Explain Simulation of Manufacturing and Material Handling Systems.	CO6

Date of Display: 22/03/2019

Date of Submission: 28/03/2019