K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CO-PO Mapping

Course: SYSTEM SIMULATION AND MODELLING			
Type: Elective		Course Code: 18CS645	
No of Hours			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
4	0	4	40
Marks			
Internal Assessment	Examination	Total	Credits
40	60	100	3

Aim/Objectives of the Course

1. To explain the basic system concept and definitions of system and discuss technique to model and to simulate various systems.
2. To understand and illustrate various techniques to generate random numbers.
3. To interpret input models and estimate their performance.
4. To utilize characteristics of queuing system and use techniques to implement statistical models.
5. To outline the verification and validation of models.

Course Learning Outcomes

After completing the course, the students will be able to

CO1	**Illustrate** the importance of system simulation and **make use of** different techniques to simulate various systems.	**Applying (K3)**
CO2	**Utilize** the properties of random numbers and generate random variates using different techniques.	**Applying (K3)**
CO3	**Interpret** the use of input models in simulation by choosing the statistical distributions and **estimate** absolute performance.	**Applying (K3)**
CO4	**Summarize** characteristics of queuing system, and **apply** suitable techniques to implement statistical models.	**Applying (K3)**
CO5	**Outline** the output performance of simulation data and **make use of** the information to improve the system performance.	**Applying (K3)**

Syllabus Content	CO1
Module 1 **Introduction:** When simulation is the appropriate tool and when it is not appropriate, Advantages and disadvantages of Simulation; Areas of application, Systems and system environment; Components of a system; Discrete and continuous systems, Model of a system; Types of Models, Discrete-Event System Simulation examples: Simulation of queuing systems. General Principles,. **LO:** At the end of this session the student will be able to, 1. List the circumstances when simulation is appropriate and not appropriate. 2. Explain system and its components.	8 hrs PO1-3 PO2-2 PO3-2 P05-2 P09-2 PO12 -1 PSO1-3

3. Explain different types of simulation models. 4. Simulate discrete event systems and analyze the system. 5. Explain event-scheduling / time-advance algorithm and apply event scheduling algorithm to simulate the system.	PSO2-3
Module 3: Random-Number Generation: Properties of random numbers; Generation of pseudo-random numbers, Techniques for generating random numbers, Tests for Random Numbers, Random-Variate Generation: Inverse transform technique, Acceptance- Rejection technique. LO: At the end of this session the student will be able to, 1. Explain different techniques for random number generation. 2. Generate random numbers using various techniques. 3. Explain and apply KS test, Chi square test, inverse transformation technique, 4. Acceptance-rejection technique. 5. Generate random variate using inverse transformation, acceptance-rejection technique.	**CO2** 8 hrs. PO1-3 PO2-2 PO3-2 P05-2 P09-2 PO12 -1 PSO1-3 PSO2-3
Module 4 : Input Modeling: Data Collection; Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models. Estimation of Absolute Performance: Types of simulations with respect to output analysis, Stochastic nature of output data, Measures of performance and their estimation. **LO:** At the end of this session the student will be able to, 1. Explain the steps involved in development of a good input model 2. Explain multivariate and time-series input models 3. Explain the types of simulation with respect to output analysis	**CO3** 8 hrs PO1-3 PO2-2 PO3-2 P05-2 P09-2 PO12 -1 PSO1-3 PSO2-3
Module 2 **Statistical Models in Simulation:** Review of terminology and concepts, Useful statistical models, Discrete distributions. Continuous distributions, Poisson process, Empirical distributions. **Queuing Models:** Characteristics of queuing systems, Queuing notation, Long-run measures of performance of queuing systems, Long-run measures of performance of queuing systems cont…,Steady-state behavior of M/G/1 queue, Networks of queues. **LO:** At the end of this session the student will be able to, 1. Explain various statistical models in simulation 2. Solve the problems using statistical models 3. Explain characteristics of queuing systems 4. Explain M/G/1 queue	**CO4** 8 hrs PO1-3 PO2-2 PO3-2 P05-2 P09-2 PO12 -1 PSO1-3 PSO2-3

Module 5: Measures of performance and their estimation, Output analysis for terminating simulations Continued.., Output analysis for steady-state simulations. **Verification, Calibration And Validation:** Optimization: Model building, verification and validation, Verification of simulation models, Verification of simulation models, Calibration and validation of models, Optimization via Simulation. **LO:** At the end of this session the student will be able to, 1. Differentiate between terminating simulation and steady state simulation. 2. Explain model building, verification and validation of simulation. 3. Explain the iterative process of calibrating a model. 4. Explain the three steps approach to validation by Naylor and Finger.	**CO5** 8hrs PO1-3 PO2-2 PO3-2 P05-2 P09-2 PO12 -1 PSO1-3 PSO2-3

Text Books

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5 th Edition, Pearson Education, 2010.

Reference Books (specify minimum two foreign authors text books)

1 Lawrence M. Leemis, Stephen K. Park: Discrete – Event Simulation: A First Course, Pearson Education, 2006.

2. Averill M. Law: Simulation Modeling and Analysis, 4th Edition, Tata McGraw-Hill.2007.

Useful Websites

- http://www.systems-thinking.org/modsim/modsim.htm
- http://web.stanford.edu/class/archive/ee/ee392m/ee392m.1056/Lecture9_ModelSim.pdf
- http://www.eolss.net/sample-chapters/c15/e1-26-05-04.pdf
- https://shamsulsarip.files.wordpress.com/2015/07/system-modelling-and-simulation.pdf

Useful Journals

- A.LisJak, G.Grasselli: "A review of discrete modeling techniques for fracturing processes in discontinuous rock masses", CSRME, volume 6, 2014.
- Luc Devroye: "The Series method for Random Variate Generation and its Application to the Kolmogrov-Smirnov Distribution", American Journal of Mathematical and Management Sciences, volume 1, 2013

Teaching and Learning Methods

1. Lecture class: 40 Hrs
2. Revision : hrs

Assessment

Type of test/examination: Written examination

Continuous Internal Evaluation(CIE) : 40 marks (Average of three tests will be considered)

Semester End Exam(SEE) : 100 marks (students have to answer all main questions) which will be reduced to 60 Marks.

Test duration: 1 :30 hrs

Examination duration: 3 hrs

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:**Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:**Environment and Society **PO8:**Ethics **PO9:**Individual & Team Work **PO10:** Communication **PO11:**Project Mngmt & Finance **PO12:**Life long Learning

PSO1: Understand fundamental and advanced concepts in the core areas of Computer Science and Engineering to analyze, design and implement the solutions for the real world problems.

PSO2: Utilize modern technological innovations efficiently in various applications to work towards the betterment of society and solve engineering problems.

O	PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO10	PO1 1	PO12	PS O1	PS O2
	K-level														
1	K3	3	2	2	-	2	-	-	-	2	-	-	1	3	3
2	K3	3	2	2	-	2	-	-	-	2	-	-	1	3	3
3	K3	3	2	2	-	2	-	-	-	2	-	-	1	3	3
4	K3	3	2	2	-	2	-	-	-	2	-	-	1	3	3
5	K3	3	2	2	-	2	-	-	-	2	-	-	1	3	3

Course In charge

Head of the Department

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Principal

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