DO NOT TYPE IN THIS BOX

Bulletin # : 6

Academic Year : 2019-2020

FLORIDA INTERNATIONAL UNIVERSITY
UNIVERSITY CURRICULUM COMMITTEE
Proposal for a New Course

CAP 4830

1. **School/College** Engineering and Computing

   Div./Dept. in Which Taught School of Computing and Information Sciences

2. CEN (Alpha Prefix) | 4 (1st Digit) | (Last 3 Digits) | (“C”-lec-lab “L”-Lab) | 3 (Cr. Hrs.)

   CIP Code *(Leave this blank):* 11.0101

3. **Grading Method (select one):** ☒ Graded ☐ Pass/Fail

4a. **Course Title** Fundamentals of Modeling & Simulations

b. **Abbreviated course Title** *(for computer class schedules, transcripts)* Modeling & Simulations

LIMITED TO 25 Characters *(including spaces)*

5. **Statewide Course Numbering Subject Matter Area** Computer Software Engineering

6. **Catalog Description/Major Topics** *(not to exceed 200 characters including spaces)*

College of Medicine and College of Law: Attach description not exceeding 1,000 characters including spaces.

Introduction to discrete-event systems, a survey of modeling tools, mathematical & statistical modeling, role of random numbers, verification & validation, and applications.

7. **Attach detailed syllabus course outline and course justification on separate page(s).**
8. **Prerequisite(s):** (STA-2023 or STA-3033) and COP-3530
9. **Corequisite(s):**
10. **Objective(s) of Course:**

Student will understand:
What are the advantages and disadvantages of different types of simulations.
The role of statistics and queues in modeling.
The role of verification and validation in modeling

11. **Does this course duplicate/overlap other courses at FIU?** ☒ No ☐ Yes

    If yes, please explain:

12. **What other closely related department(s) have been consulted about this course?**

13. **Is this course used for the assessment of a program or a certificate (if yes, then send a notification to assessment@fiu.edu)?** No Yes

PROPOSAL REQUESTED BY:

Faculty Contact William B Feild, Jr (Type name) — (Signature) — 3 / 16 / 2020

wfeildjr@fiu.edu (Email address) — 305 348-8034 (Phone number)

Chairperson (Dept./Div.) S.S. Iyengar (Type name) — (Signature) — 3 / 16 / 2020

Chairperson (Curr. Comm.) Wei-Chiang Lin (Type name) — (Signature) — / / 2020

College/School Dean John Volakis (Type name) — (Signature) — 3 / 30 / 2020

Submit one original form. Attach one copy of the course justification and course syllabus, course description, objectives, major topics and textbooks.

Fundamentals of Modeling & Simulations - Course Justification

Simulation enables the study of, and experimentation with, interactions of a complex system. Changes can be made to parameters or components of the simulation model, and the effect of those alterations on the model's behavior can be readily observed. Furthermore, changing simulation inputs and observing the resulting outputs can produce valuable insights into which variables are most important and most sensitive. Additionally, simulation models can be used to verify analytic solutions, or provide analysis of systems deemed to complex to analyze mathematically.

The fundamental advantage to the use of modeling and simulations (M&S) is cost. The cost of building and operating an effective digital model or simulation is almost always a fraction of the cost to actually build and operate a physical model or simulation. Many modern systems are so complex that study of their interactions can only be done through simulation.

Amongst numerous disciplines there is a growing demand for expertise in the building of models and simulations - business, engineering, government, etc. Consequently, there is a critical need for a course that provides the fundamentals of M&S: discrete-event systems, available M&S tools, mathematical and statistical modeling, verification and validation and other applications that leverage the advantages of M&S. This undergraduate-level course will thoroughly prepare students with the tools and ideas required to understand and develop a broad spectrum of M&S applications.

There are many industrial, and academic positions available in high-tech companies, national labs, universities and government requiring people with CS-related degrees who have solid understanding of M&S. This course can pave the way for the students who seek such positions, and also prepare them for more rigorous graduate-level courses in M&S.

School of Computing and Information Sciences

Course Title: Fundamentals of Modeling & Simulations **Date:** 3/5/2020

Course Number: CAP-4xxx

Number of Credits: 3

Subject Area: Computer Applications	**Subject Area Coordinator:** Mark Finlayson **email:** markaf@fiu.edu
Catalog Description: Introduction to discrete-event systems, a survey of modeling tools, mathematical & statistical modeling, role of random numbers, verification & validation, and applications.	
Textbook: Banks, Carson, Nelson & Nicol – Discrete-Event System Simulation, 5th Edition, Pearson, 2010, 978-0136062127	
References:	
Prerequisites Courses: (STA-2023 or STA-3033) and COP-3530	
Corequisite Courses: None	

School of Computing and Information Sciences
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Fundamentals of Modeling and Simulations

Type: Elective for CS (Applications group)

Prerequisites Topics:

1. Basic techniques of algorithm analysis and problem solving
2. Familiar with basic data structures, e.g. queues and stacks
3. Familiar with encapsulation using functions
4. Familiar with concepts of probability
5. Familiar with random variables and their distributions

Course Outcomes:

1. Be familiar with the history, advantages, and disadvantages of simulations.
2. Be familiar with a variety of simulation environments and tools.
3. Be familiar with concepts in discrete-event simulation models.
4. Be familiar with statistical models and discrete distributions.
5. Be exposed to random numbers and their generation.
6. Be exposed to input modeling and parameter estimation.
7. Be familiar with verification, validation, and documentation of simulation models.
8. Master development of simulation models to address topics in the above outcomes.

Relationship between Course Outcomes and Program Outcomes

BS in CS: Program Outcomes	Course Outcomes
a) Demonstrate proficiency in the foundation areas of Computer Science including mathematics, discrete structures, logic and the theory of algorithms	1, 2, 3, 4, 5, 6, 7, 8
b) Demonstrate proficiency in various areas of Computer Science including data structures and algorithms, concepts of programming languages and computer systems.	3, 4, 5, 6, 7, 8
c) Demonstrate proficiency in problem solving and application of software engineering techniques	7, 8
d) Demonstrate mastery of at least one modern programming language and proficiency in at least one other.	
e) Demonstrate understanding of the social and ethical concerns of the practicing computer scientist.	
f) Demonstrate the ability to work cooperatively in teams.	
g) Demonstrate effective communication skills.	

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Fundamentals of Modeling and Simulations

Assessment Plan for the Course & how Data in the Course are used to assess Program Outcomes

Student and Instructor Course Outcome Surveys are administered at the conclusion of each offering, and are evaluated as described in the School's Assessment Plan: http://www.cis.fiu.edu/programs/undergrad/cs/assessment/

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Fundamentals of Modeling and Simulations

Outline

Topic	Number of Lecture Hours	Outcome
1. Introduction to Simulations 1.1. Brief History 1.2. Advantages & disadvantages 1.3. Components of Systems and Simulations 1.4. Steps in a simulation design	8	1
2. Simulation Environments and Tools 2.1. Spreadsheets 2.2. Software 2.3. Environments	5	2, 8
3. Concepts in Discrete-Event Simulation 3.1. Event scheduling 3.2. Event processing	5	3, 8
4. Statistical Models and Discrete Distributions 4.1. Terminology 4.2. Queueing and supply-chain systems 4.3. Reliability 4.4. Discrete distributions	5	4, 8
5. Random-Number Generation 5.1. Properties of Random numbers 5.2. Generation of pseudo-random numbers 5.3. Techniques for generation random numbers	5	5, 8
6. Input Modeling and Parameter Estimation 6.1. Data collection 6.2. Identifying distributions 6.3. Parameter estimation 6.4. Goodness-of-fit tests 6.5. Selecting input models	5	6, 8
7. Verification and Validation 7.1. Model building and V&V 7.2. Verification 7.3. Validation 7.4. Documentation	5	7, 8

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Fundamentals of Modeling and Simulations

Course Outcomes Emphasized in Laboratory Projects / Assignments

Outcome	Number of Weeks
Introduction to simulations 1	2
Simulation environments and tools 2,8	2
Concepts in discrete-event simulation 3,8	2
Statistical models and discrete distributions 4,8	2
Random number generation 5,8	2
Input modeling and parameter estimation 6,8	2
Verification and validation 7,8	2

Oral and Written Communication

No significant coverage

Written Reports		Oral Presentations	
Number Required	Approx. Number of pages	Number Required	Approx. Time for each
0	0	0	0

Social and Ethical Implications of Computing Topics

No significant coverage

Topic	Class time	student performance measures

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Fundamentals of Modeling and Simulations

Approximate number of credit hours devoted to fundamental CS topics

Fundamental CS Area	Core Hours	Advanced Hours
Algorithms:		
Software Design:		
Computer Organization and Architecture:		
Data Structures:		
Concepts of Programming Languages		

Theoretical Contents

Topic	Class time

Problem Analysis Experiences

Solution Design Experiences

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Fundamentals of Modeling and Simulations

The Coverage of Knowledge Units within Computer Science Body of Knowledge[1]

Knowledge Unit	Topic	Type	Lecture Hours

[1]See Appendix A in Computer Science Curricula 2013 at:
https://www.acm.org/binaries/content/assets/education/cs2013_web_final.pdf