COLLEGE OF ENGINEERING

DEPARTMENT OF COMPUTER

COURSE SYLLABUS/ SPECIFICATION

Course Code & Title: ECCE 507- Modeling & Simulation

Weight: 3-0-3

Prerequisite: None

NQF Level Allocated: 9 **NQF Notional Hours / Credits:** 120/12

Description: The purpose of this course is to introduce the fundamental concepts in the general area of modeling and simulation. Topics include principles of modeling and simulation, basics of discrete-event simulation, simulation software, mathematical and statistical models, queuing models, simulation design, modelling of simulation data, and output statistics. Concepts are illustrated with examples of simulation of computer systems and networks.

Objective:

1. To overview concepts and principles of modeling and simulation and survey current simulation software.
2. To discuss Simulations methodologies such as Discrete-Event simulation and statistical modeling of physical systems.
3. To explore system modeling using queuing theory approach and its use in modeling computer systems and networks.
4. To effectively use simulation packages to model and simulate computer systems and networks.

Semester:

Instructor (s):

Office Telephone: 17298999 Ext.: 8674 **Email (s):**

Intended Learning Outcomes (ILOs):

A. Knowledge and Understanding	NQF Descriptor/ Level
A1. Concepts and Theories: Demonstrate understanding of concepts and theories of systems modeling and simulation including embedded theory drawing on probability and statistics.	Knowledge: theoretical understanding [Level 9]
A2. Contemporary Trends, Problems and Research: Understand the evolution of modeling and simulation schemes in applied to IT and Computer Science.	Knowledge: theoretical understanding [Level 9]
A3. Professional Responsibility: Demonstrate knowledge and understanding of professional responsibility and accountability areas related to the use of modeling and simulation in IT and Engineering, such as the use of incomplete models or the use of models beyond their scope or applicability.	Knowledge: theoretical understanding [Level 9]

B. Subject-Specific Skills	NQF Level
B1. Problem Solving: demonstrate professional level of insight and originality in identifying appropriate models for solving simulation problems in areas of IT and computer science.	Knowledge: theoretical Understanding [Level 9] Generic problem solving and analytical skills [Level 9]
B2. Modeling and Design: Design and run simulation models applicable to a variety of contexts (e.g. discrete events).	Knowledge: Practical application [Level 9] Competence : Context[level 8]
B3. Application of Methods and Tools**:** Apply specific simulation schemes and use appropriate simulation packages such as Simulink to solve problems at hand.	Knowledge: Practical application [Level 9] Skills: Communication, ICT and Numeracy [Level 9]

C. Critical Thinking Skills	NQF Level
C1. Analytic: Critically evaluate and test employed models/simulation methods and evaluate the results of output.	Generic problem solving and analytical skills [Level 9] Skills: Communication, ICT and Numeracy [Level 9] Knowledge: Practical Application [Level 9]
C2. Synthetic: Integrate results generated from a variety of simulation designs to mimic computer systems/ networks.	Generic problem solving and analytical skills [Level 9] Knowledge: Practical Application [Level 9]
C3. Creative: Inject creativity into model formulation and simulation design.	Generic problem solving and analytical skills [Level 9] Knowledge: Practical Application [Level 9]

D. General and Transferable Skills	NQF Level
D1. Communication: Present solutions to modeling and simulation problems and express ideas cogently and effectively in written and oral forms.	Communication, ICT and Numeracy Skills [Level 9]
D2. Teamwork and Leadership: Work effectively as a member of a project team and demonstrate understanding of individual responsibility within the team.	Competence: Autonomy, Responsibility and Context [Level 8]
D3. Organizational and Developmental Skills: demonstrate professional skills in planning, managing , and allocating time effectively in assigned tasks such as group projects and assignments.	Competence: Autonomy, Responsibility and Context [Level 8]

Course Structure (Outline)

Week	Hours	ILOs	Unit/Module or Topic Title	Teaching Method	Assessment Method
1	3	A1, A2, A3	Introduction to modeling and simulation	Lecture	-
2	3	A1, A2, A3, D1	Simulation Examples - General Principles in Simulation	Lecture Discussion	Oral Enquiry*(A1,D1)
3	3	A1, A2,A3, D1	Modeling :concepts and principles Overview of Simulation Software	Lecture Discussion	Oral Enquiry*(A1,D1) Assignment 1 (A1,A2,A3,D1)
4	3	A1,A2,A3,D 1	Discrete-event simulation (DES)	Lecture Discussion	Oral Enquiry*(A1,A2,D1)
5	3	A1, B1,B2, B3,C1,D1	DES : Modeling and simulation with Simulink	Lecture, Lab demo/ supervised individual lab work	Oral Enquiry*(A1,D1) Assignment 2 (B1,B2,B3,D1)
6	3	A1,B1, D1	Review on Probability Theory and Statistics	Lecture Tutorial	Oral Enquiry*(A1,D1) In-class Exercises*(A1,B1)
7	3	A1,B1,C, D1	Statistical models in Simulation Assignment of Team Project	Lecture Tutorial Discussion	Oral Enquiry*(A1,D1) In-class Exercises* (A1,B1,C1)
8	3	A1,B1, B2,C1,D1	Random Number Generator	Lecture Tutorial	Oral Enquiry*(A1,D1) In-class Exercises*(A1,B1) Assignment 3 (B1,B2,C1,D1)
9	3	A1,B1,B2,C 1,C2,D1	Output Analysis	Lecture tutorial	Oral Enquiry*(A1,D1) Midterm Exam (A1,B1,B2,C1,C2, D1)

10 & 11	6	A1, A2,B,B2, B3,C1,C3, D1	Queuing Theory and Models	Lectures Tutorial	Oral Enquiry*(A1,D1) In-class Exercises*(A1,B1,C1) Assignment 4 (A1,B1,B2,B3,C1,C3,D1)
12	3	B1, B2, B3,C1,C2,D 1	Modeling Queuing systems with Simulink	Lecture, supervised individual lab work	Oral Enquiry*(B1,D1)
13	3	A1, B1, B2, B3,C1,C2,C 3,D1	Modeling and Simulation of Computer Systems . Simulink application.	Lecture, supervised individual lab work	Oral Enquiry*(A1,B1,D1)
14	3	A1, B1, B2,B3,C1,C 2,C3,D1	Modeling and Simulation of Computer Networks. Simulink application.	Lecture, supervised individual lab work	Oral Enquiry*(A1,B1,D1)
15	3	A1, A2, B1, B2, B3,C1, C2,C3,D1,D 2,D3	Project Presentation by Students		Project Evaluation (A1,A2,B1,B2,B3,C1,C2,C3,D1,D2, D3)
16	2				Final Exam (A1,B1,B2,C1,C2, D1)

* Formative assessment

Teaching Materials:

Textbook(s):	Byoung Kyu Choi, DongHun Kang, Modeling and Simulation of Discrete Event Systems, 1st edition, Wiley, 2013.
Handout(s):	Lecture slides and notes Other resources are available on the Course website (Moodle system)
Reference(s):	Byoung Kyu Choi, DongHun Kang, Modeling and Simulation of Discrete Event Systems, 1st edition, Wiley, 2013. Lecture slides and notes Other resources are available on the Course website (Moodle system) **Reference Texts/Papers/Journals:** 1. Jerry Banks et al, Discrete-Event System Simulation , 5th Edition, Prentice Hall, 2010. 2. Frank L. Severence, System Modeling and Simulation, Wiley India Pvt. Limited, 2009 3. Adil Adil Nazir Malik, Modeling and Simulation of computer Networks Using OPNET , LAP LAMBERT Academic Publishing, December 2012

	4. Harold Klee , Randal Allen , Simulation of Dynamic Systems with MATLAB and Simulink, CRC Press, 2nd Edition, February 2011 5. An Overview of the OMNeT++ Simulation Environment,Andras Varga 7 Rudolph Hornig, SIMUTools, March 03 – 07, 2008, Marseille, France. 6. Simulation Modeling Practice and Theory ,International Journal of the Federation of European Simulation Societies - EUROSIM 7. International Journal of Modeling and Simulation, ACTA Press 8. Journal of Modeling and Simulation in Engineering, Hindawi Publishing Corporation 9. World Journal of Modelling and Simulation, World Academic Press, World Academic Union , England , UK 10. Journal of Modelling and Simulation of Systems (JMSS), HyperSciences Publisher Journal of Simulation Modelling Practice and Theory, Elsevier

Assessment

Type of Assessment[1]	Description[2]	ILOs[3]	Weighting
Assignment 1	*Four assignments are assigned throughout the course.* *<u>Assignment 1</u>: A research assignment is assigned in the 3rd week of the course. Students are requested to read selected literature on modeling and simulation and discusse the reasons behind simulating real world systems and analyze the different types of simulation currently in use in the area of IT and computer science , then draw a conclusion of the most appropriate schemes to apply to computer and networks systems. The students are expected to submit a four-page report within three weeks. Selected literature is made available on the course website at the beginning of the course.* *<u>Assignment 2:</u> students use DES and computer software (SIMULINK) to model and simulate a variety of simple systems.*	A1,A2,A3,D1	10% each
Assignment 2	*<u>Assignment3:</u> students solve a set of exercises using statistical modeling of specific systems.* *<u>Assignment4</u>: students are asked to model specific computer/network systems using queuing*	B1,B2,B3,D1	Average 20 %
Assignment 3		B1,B2, C1,D1	

Assignment 4	*theory/data structures and proceed with a computer implementation of the simulation .* *Assignments are to be handed in electronically or uploaded on the Moodle system on the due date. Plagiarized work will be penalized.*	A1,B1,B2,B3,C1,C3,D1	
Midterm Exam	*The test is open book , open notes, is of one hour and 30 min duration, and consists of short essay questions and problem solving-based short answer questions (SAQs)*	A1,B1,B2,C1,C2, D1	20 %
Team Project	*A project is assigned in week 7 of the course and consists of a comprehensive computer simulation of a computer/network system (e.g.: wireless networks) followed by an output analysis of the simulation results in order to assess the effectiveness of the implemented simulation scheme. Students are required to work in teams of at least two members.* *In the final week, each student is required to make a presentation of his/her project contribution. Projects are evaluated according to a university-approved marking rubric.*	A1,A2,A3,B1,B2,B3,C1,C2,C3,D1,D2,D3	20%
Final Examination	*The final exam is open book, open notes , of two and a half hours duration and consists of Multiple Choice Questions (MCQs), short essay questions, and problem solving-based short answer questions (SAQs).*	A1,B1,B2,C1,C2, D1	40 %
Oral Enquiry	*Questions are asked continuously to assess student understanding in the different topics covered in class.*	A1,A2,A3,D1	Formative Assessment
In-class exercises	*Supervised problem solving or lab exercises with instructor's feedback*	A1,B1,C1	Formative Assessment
		Overall:	**100%**

13. Admissions	
Pre-requisites	No Pre-requisite course, but knowledge of probability and statistics may be required
Minimum number of students	4
Maximum number of students	20