



جمهورية مصر العربية

وزارة التعليم العالي والبحث العلمي

Ministry of Higher Education and Scientific Research



المعهد العالى للحاسبات وتكنولوجيا المعلومات  
مدينة الشروق - القاهرة  
شعبة علوم الحاسب

## Course specification

**Course Code:** CS 351

**Course Title:** Simulation and Modeling

**Academic Year:** /

**Course specification**  
**(CS 351 - Simulation and Modeling)**

**Course Outline**

<b>Faculty:</b>	<i>HICIT- (Higher Institute for Computers &amp; Information Technology-El Shorouk Academy)</i>		
<b>Program(s) on which the course is given:</b>	The undergraduate program in Computer Science		
<b>Major or minor element of the program:</b>	Compulsory		
<b>Department offering the program</b>	Department of Computer Science		
<b>Department offering the course:</b>	Department of Computer Science		
<b>Level</b>	Third Level		
<b>Date of specification approval</b>	DD/MM/YYYY		

**Basic Information**

<b>Code:</b>	CS 351	<b>Title:</b>	Simulation and Modeling	
<b>Prerequisites:</b>	CS 312 Analysis of Algorithms			
<b>Weekly Hours:</b>				
<b>Lecture: 2</b>	<b>Exercise: 2</b>	<b>Practical:</b>	<b>Total: 3 credit hours</b>	

**Professional Information**

**Course Aims:**

This course (CS 351) introduces the student to Computer modeling & simulation. During the study of this course, the Basic concepts and terminology of simulation, probability and distribution theory, estimation and statistical tests, and generation of random numbers are discussed.

This course introduces the queuing theory, discrete system simulation, and examples such as M/M/1. Then this course discusses time management methods such as time-driven and event-driven simulation.

This Course explains the Simulation languages, introduction to continuous systems simulation, and examples.

## Program ILOs Covered by Course

Knowledge and understanding	Intellectual Skills	Professional and practical skills	General and Transferable skills
A14, A21	B1, B2, B4, B7, B8, B13, B15	C6, C16	D11

a14	Demonstrate strong knowledge of fundamentals of Data Warehousing, data structures and algorithms.
a21	Identify Modeling and design of computer-based systems bearing in mind the trade-offs
b1	Define traditional and non-traditional problems, set goals towards solving them, and observe results.
b2	Perform comparisons between (algorithms, methods, techniques, etc.).
b4	Identify attributes, components, relationships, patterns, main ideas, and errors.
b7	Establish criteria, and verify solutions.
b8	Identify a range of solutions and critically evaluate and justify proposed design solutions.
b13	Analyze and evaluate a range of options in producing a solution to an identified problem.
b15	Apply the concepts, principles, theories and practices underpinning computing as an academic discipline.
c6	Evaluate systems in terms of general quality attributes and possible trade-offs presented within the given problem.
c16	Apply tools and techniques for the design and development of applications.
d11	Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.

## Intended learning outcomes of the course (ILOs)

### **a. Knowledge and understanding:**

- a1. Define The basic concept of simulation [A14].
- a2. Explain the queuing theory [A14].
- a3. Explain the principles, concepts, and practical design of simulated systems [A14].
- a4. Explain Input modeling, and random numbers' generators [A21].

### **b. Intellectual Skills:**

- b1. Analyze a comprehensive and state-of-the-art treatment of all the important aspects of a simulation study [B1, B2].
- b2. Differentiate between model verification and validation [B2, B4].
- b3. Interpret statistical design and analysis of simulation experiments [B4, B7].

### **c. Professional and practical skills**

- c1. Implement several simulation experiments [C6].
- c2. Measure the values of Simulation parameters and indicate their advantages and disadvantages [C6, C16].
- c3. Discuss various Simulation techniques [C16].

### **d. General and transferable skills**

- d1. Work effectively as an individual and as a member of a team [D11].
- d2. Write technical Report [D11].

Topic	Contact Hours	
	lecture	Exc
Basic concepts and terminology <ul style="list-style-type: none"> <li>• Concepts of a system</li> <li>• System Methodology</li> <li>• Advantages and disadvantages of simulation terminology</li> </ul>	2	2
Probability and distribution theory <ul style="list-style-type: none"> <li>• Probability</li> <li>• Set theory, compound events</li> <li>• Conditional probability, independent events</li> <li>• Discrete distributions</li> <li>• Continuous distributions</li> <li>• Function of a random variable</li> <li>• Moments Some common distributions</li> </ul>	4	4
Estimation and statistical tests <ul style="list-style-type: none"> <li>• Empirical distributions</li> <li>• Estimation</li> <li>• Tests of hypotheses</li> <li>• The Chi-Squire goodness-of-fit test</li> <li>• The Kolmogorov-Smirnov test</li> </ul>	4	4
Generation of Random Numbers <ul style="list-style-type: none"> <li>• Pseudo-random numbers</li> <li>• Congruential generators</li> <li>• Testing and validating Pseudo-random numbers</li> </ul>	2	2
Introduction to queuing theory <ul style="list-style-type: none"> <li>• Review of the Poisson and Exponential distributions</li> <li>• The M/M/1/∞/FIFO system</li> <li>• Summary measures for the M/M/1/∞/FIFO system</li> <li>• The M/M/1/k/FIFO system</li> <li>• M/M/C/∞/FIFO system</li> </ul>	6	6
Discrete system simulation <ul style="list-style-type: none"> <li>• Examples</li> <li>• Time management methods,</li> <li>• Collecting and recording simulation data</li> <li>• Analysis of simulation results</li> <li>• Evaluation of the simulation model</li> </ul>	6	6
Languages for discrete system simulation <ul style="list-style-type: none"> <li>• Language Characteristics</li> <li>• Use multipurpose languages</li> <li>• Special-purpose languages:               <ul style="list-style-type: none"> <li>○ GPSS</li> <li>○ SIMSCRIPT II.5</li> <li>○ SLAM II</li> </ul> </li> </ul>	4	4
Introduction to continuous system simulation. <ul style="list-style-type: none"> <li>• Models of continuous systems</li> <li>• Solution of linear differential equations</li> <li>• Analog computing</li> <li>• Digital simulation of continuous systems</li> </ul>	2	2
Selected Topics (Continuous system simulation languages)	2	2

### Teaching and learning methods

Teaching and learning methods	Used
Lectures	√
Tutorial Exercises	√
Practical Lab	-
Discussions.	√
Self – Learning (Reading material, Websites search,)	√
Self-studies	√
Group work	√
Presentation	√
Problem-solving/problem-solving learning based	√
Case study	√
Synchronous E-Learning	-
Video lectures	√
Asynchronous E-Learning	√

### Student assessment methods & Schedule

Methods	Used	Week #
Midterm Exam	√	8
Final Exam	√	16
Course Project	-	-
Course Work & Quizzes	√	2 - 14
Practical Exam	-	-

### Assessment Weight

Assessment	Weight %
Mid Term Exam	20
Practical Exam and Project	-
Final Exam	60
Course Work & Quizzes	20
Total	100

### Course Work & Quizzes

Short Exams, Assignments, Research, Reports, Presentations
Class discussion

### List of references

<b>Essential books (textbooks)</b>	Abdul Karim, Samsul Ariffin, editor. Intelligent Systems Modeling and Simulation II: Machine Learning, Neural Networks, Efficient Numerical Algorithm and Statistical Methods. Springer, 2022. Law. Simulation Modeling and Analysis. 2015.
<b>Course notes</b>	E-Learning Portal

<b>Recommended books</b>	Dr. Nilesh Patil, editor. Simulation and Modeling For MU Sem 8 I.T Information Technology Course Code: ITDO8013, Tech-Neo Publications, 2023
<b>Periodicals, website</b>	PowerPoint presentations of all course materials All exercises material [ <a href="https://learn.sha.edu.eg/course/view.php?id=1367">https://learn.sha.edu.eg/course/view.php?id=1367</a> ]
<b>Videos link</b>	

### Required Facilities

Tools & SW (Technology facilities):	<ul style="list-style-type: none"> <li>- Microsoft TEAMS to create virtual classrooms for lectures, discussions, and tutorials.</li> <li>- Academy Portal (MOODLE) to make electronic quizzes and electronic midterm exam.</li> <li>- Academy Portal (MOODLE) to upload assignments.</li> <li>- Academy portal (MOODLE) to upload electronic material.</li> </ul>	
Teaching facilities:	Whiteboard	√
	Computer Lab	√
	Data show	√
	E-Learning	√
	Videos	√
	Website	√

### Course Content /ILOs Matrix

Course Contents	Knowledge & understanding				Intellectual skills			Professional and practical skills			General	
	a1	a2	a3	a4	b1	b2	b3	c1	c2	c3	d1	d2
Basic concepts and terminology	√	√	√	√							√	√
Probability and distribution theory					√	√	√					
Estimation and statistical tests					√	√	√	√	√	√		
Generation of Random Numbers					√	√	√	√	√	√		
Introduction to queuing theory	√	√	√								√	√
Discrete system simulation					√	√	√					
Languages for discrete system simulation					√	√	√					
Introduction to continuous system simulation	√	√	√								√	√
Selected Topics (continuous simulation)					√	√	√	√	√	√		

### Learning Method /ILOs Matrix

Learning Methods	Knowledge and understanding				Intellectual skills			Professional and practical skills			General	
	a1	a2	a3	a4	b1	b2	b3	c1	c2	c3	d1	d2
Lectures	x	x	x	x	x	x	x	x	x	x		
Tutorial Exercises					x	x	x	x	x	x		x
Reading material	x	x	x	x	x	x	x	x	x	x		
Websites search	x	x	x	x	x	x	x		x		x	
Research and reporting	x	x	x	x								x
Problem solving							x				x	x
Group work								x	x	x	x	
Case study					x		x	x	x			
Practical Lab					x	x	x	x	x	x		
Discussions.					x	x	x	x	x	x	x	

### Assessment Methods /ILOs Matrix

Assessment Methods	Knowledge & understanding				Assessment Methods			Knowledge & understanding			Assessment Methods	
	a1	a2	a3	a4	b1	b2	b3	c1	c2	c3	d1	d2
Mid Term Exam	x	x	x	x	x	x	x	x				
Final Exam	x	x	x	x	x	x	x	x				
Course Project	x	x	x	x	x	x	x	x	x	x	x	
Course Work & Quizzes	x	x	x	x	x	x	x	x	x	x	x	x
Practical Exam	x	x	x	x	x	x	x	x	x	x	x	

Course ILOs Vs Program ILOs													
Prog ILOs Course ILOs		Knowledge & understanding		Intellectual skills						Professional and practical skills		General	
		A14	A21	B1	B2	B4	B7	B8	B13	B15	C6	C16	D11
Knowledge and Understanding	a1	√											
	a2	√											
	a3	√											
	a4		√										
Intellectual skills	b1			√	√								
	b2				√	√							
	b3					√	√						
Professional and practical skills	c1							√			√		
	c2									√	√		
	c3								√		√		
General skills	d1												√
	d2												√

**Course Coordinator** : Dr. Farouk Shaaban ( )

**Head of Department** : Dr. Ahmed El-Abbassy ( )

**Date**: --/--/2023