هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title ::Modeling and Simulation
Course Code: **CS1755**
Program: : Computer Science
Department: : Computer Science& Engineering
College: Computer Science and Information Technology
Institution: **Albaha University**
Version: **T153**
Last Revision Date: **23/05/2023**

Table of Contents:

rse Identification

redit hours:	3

ourse type

University ☐ College ☐ Department ☒ Track☐ Othe

Required ☒ Elective☐

evel/year at which this course is ed:	

ourse general Description

urpose of this course is to introduce computer simulation technologies and techniques modeling. It provides the foundations for the student to understand computer simulatic , and to implement and test a variety of simulation and data analysis libraries and progr ourse focuses on what is needed to build simulation software environments, and not ju ng simulations using pre-existing packages. Introduce concepts of modeling layers of y's critical infrastructure networks. Build tools to view and control simulations and thei

results.

5. Pre-requirements for this course (if any):Design and Analysis of Algorithms (CS1506)

6. Co- requirements for this course (if any):

7. Course Main Objective(s)

Students will be exposed to the details of modeling and simulation technologies. They will co the following:

- Define the basics of simulation modeling and replicating the practical situations in organizations
- Develop a simulation model using heuristic methods.
- Generate random numbers and random varieties using different techniques.
- Analysis of Simulation models using input analyzer, and output analyzer
- Explain Verification and Validation of simulation model.

1. Teaching mode(mark all that apply)

Mode of Instruction	Contact Hours	Percenta
Traditional classroom		
E-learning		
Hybrid ● Traditional classroom ● E-learning		 90% 10%
Distance learning		

2. Contact Hours (based on the academic semester)

Activity	Contact Ho
Lectures	33
Laboratory/Studio	
Field	
Tutorial	
Others (specify)	
Total	33

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessm Metho
	Knowledge and understanding			
	Describe the role of important elements of discrete event simulation and modeling paradigm.		▪ Lectures ▪ Discussions	-Homewor rubric -Midterm e -Final exa
	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.		▪ Lectures ▪ Discussions	-Homewor rubric -Midterm e -Final exa
	Skills			
	Interpret the model and apply the results to resolve critical issues in a real world environment.		▪ Lectures ▪ Discussions	-Homewor rubric -Midterm e -Final exa
	Apply random numbers and variates to develop simulation models		▪ Lectures ▪ Discussions	-Homewor rubric -Quiz -Final exa
	Analyze output data produced by a model and test validity of the model		▪ Lectures ▪ Discussions	-Homewor rubric -Quiz -Final exa
	Explain the concepts of verification and validation		▪ Lectures ▪ Discussions	-Homewor rubric -Final exa
	Values, autonomy, and responsibility			
	Ability to work independently and collaboratively	V1	Assignments	-Homewor Rubric -Group p Rubric
	Ability to meet deadlines on assignments and	V1	Assignments	-Homewor Rubric -Group p

		projects.			Rubric
...					

C. Course Content

List of Topics	Contact H
UNIT – 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, Steps in a Simulation Study, The basics of SpreadSheet-Simulation, Simulation Example: Simulation of queuing systems in a spreadsheet	5
UNIT-2 -General Principles, Simulation Software : Concepts in Discrete-Event Simulation, The Event-Scheduling / Time-Advance Algorithm, World Views Manual simulation Using Event Scheduling ,List processing ,Basic properties, Operations-Using Arrays, Dynamic Allocation ,Linked Lists-Simulation in Java -Simulation in GPSS	5
UNIT 3- Statistical Models in Simulation: Review of terminology, concepts, Useful statistical models, Discrete Distributions ,Continuous Distributions, Poisson Process, Empirical distributions.	4
UNIT 4 - Queuing Models: Characteristics of queuing Systems, Queuing notation , Long-run measures of performance of queuing Systems, Steady-state behavior of M/G/1 queue, Networks of queues ,Rough-cut modeling: An illustration	4
UNIT 5- Random-Number Generation, Random-Variate 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, Special properties	6
UNIT 6 -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 , Multi-variate and Time-Series input models	3
UNIT 7 –Estimation Of Absolute performance[Output Analysis For A Single Model : Types of simulations with Respect to Output analysis , Stochastic Nature of Output Data, Measures of Performance and their Estimation ,Output Analysis for Terminating Simulations, Output analysis for steady-State Simulations. Problems	3
UNIT - 8 -Verification, Calibration, and Validation; Optimization of simulation Models : Model Building, Verification, Validation, Verification of simulation models, Calibration, Validation of models , Optimization, Optimization via Simulation	3
Total	33

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of T Assessment Sc
1.	Midterm exam	Week 6	20%
2.	Quiz	Week 9	15%
3	Project	Week 11	15%
4	Final Exam	Week 12-13	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

sential References	• Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulat (Listed topics only from Chapters-1 to 12), 5th Edition, Pearson Education ©2013
pportive References	• Averill M. Law: Simulation Modeling and Anal 4th Edition, Tata McGraw-Hill, 2007.ISBN : 9780070667334 • Lawrence M. Leemis, Stephen K. Park: Discret Event Simulation: A First Course,Pearson Education, 2006.ISBN: 978-0131429178
lectronic Materials	• ACM (Association for Computer Machinery) v site - http://www.acm.org/ • Open access course material online
er Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities lassrooms, laboratories, exhibition rooms, simulation rooms, etc.)	A classroom or lecture hall with whiteboar 35 students.
Technology equipment projector, smart board, software)	● A classroom with high speed Interne connection ● A digital image projection system in classroom that is connected to instru desktop computer ● Has connection for laptop plug-in

Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

ssessment Areas/Issues	Assessor	Assessment Meth
tiveness of teaching		
tiveness of students ssment	Faculty	Direct
ty of learning resources	Peer Reviewer	Direct
extent to which CLOs have achieved	Faculty	Direct
r		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods(Direct, Indirect)

G. Specification Approval Data

A. General information about the course:

Course Identification					
1. Credit hours:	3				
2. Course type					
a.	University ☐	College ☐	Department ☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered:					
4. Course general Description The purpose of this course is to introduce computer simulation technologies and techniques for data modeling. It provides the foundations for the student to understand computer simulation needs, and to implement and test a variety of simulation and data analysis libraries and programs. This course focuses on what is needed to build simulation software environments, and not just building simulations using pre-existing packages. Introduce concepts of modeling layers of society's critical infrastructure networks. Build tools to view and control simulations and their results.					
5. Pre-requirements for this course (if any):Design and Analysis of Algorithms (CS1506)					
6. Co- requirements for this course (if any):					
7. Course Main Objective(s) Students will be exposed to the details of modeling and simulation technologies. They will cover the following: ● Define the basics of simulation modeling and replicating the practical situations in organizations ● Develop a simulation model using heuristic methods. ● Generate random numbers and random varieties using different techniques. ● Analysis of Simulation models using input analyzer, and output analyzer ● Explain Verification and Validation of simulation model.					

1. Teaching mode(mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
5.	Traditional classroom		
6.	E-learning		
7.	Hybrid ● Traditional classroom		90%

No	Mode of Instruction	Contact Hours	Percentage
	● E-learning		10%
8.	Distance learning		

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
6.	Lectures	33
7.	Laboratory/Studio	
8.	Field	
9.	Tutorial	
10.	Others (specify)	
	Total	33

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Describe the role of important elements of discrete event simulation and modeling paradigm.		▪ Lectures ▪ Discussions	-Homework rubric -Midterm exam -Final exam
1.2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.		▪ Lectures ▪ Discussions	-Homework rubric -Midterm exam -Final exam
…				
2.0	Skills			
2.1	Interpret the model and apply the results to resolve critical issues in a real world environment.		▪ Lectures ▪ Discussions	-Homework rubric -Midterm exam -Final exam
2.2	Apply random numbers and variates to develop simulation models		▪ Lectures ▪ Discussions	-Homework rubric -Quiz -Final exam
2.3	Analyze output data produced by a model and test validity of the model		▪ Lectures ▪ Discussions	-Homework rubric -Quiz -Final exam
2.4	Explain the concepts of verification and validation		▪ Lectures ▪ Discussions	-Homework rubric -Final exam
3.0	Values, autonomy, and responsibility			
3.1	Ability to work independently and collaboratively	V1	Assignments	-Homework Rubric -Group project Rubric
3.2	Ability to meet deadlines on assignments and projects.	V1	Assignments	-Homework Rubric -Group project Rubric
...				

C. Course Content

No	List of Topics	Contact Hours
3.	**UNIT – 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, Steps in a Simulation Study, The basics of SpreadSheet-Simulation, Simulation Example: Simulation of queuing systems in a spreadsheet	5
4.	**UNIT-2 -General Principles, Simulation Software** : Concepts in Discrete-Event Simulation, The Event-Scheduling / Time-Advance Algorithm, World Views Manual simulation Using Event Scheduling ,List processing ,Basic properties, Operations-Using Arrays, Dynamic Allocation ,Linked Lists-Simulation in Java -Simulation in GPSS	5
3.	**UNIT 3- Statistical Models in Simulation**: Review of terminology, concepts, Useful statistical models, Discrete Distributions ,Continuous Distributions, Poisson Process, Empirical distributions.	4
4.	**UNIT 4 - Queuing Models**: Characteristics of queuing Systems, Queuing notation , Long-run measures of performance of queuing Systems, Steady-state behavior of M/G/1 queue, Networks of queues ,Rough-cut modeling: An illustration	4
5.	**UNIT 5- Random-Number Generation, Random-Variate 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, Special properties	6
6.	**UNIT 6 -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 , Multi-variate and Time-Series input models	3
7.	**UNIT 7 –Estimation Of Absolute performance[Output Analysis For A Single Model :** Types of simulations with Respect to Output analysis , Stochastic Nature of Output Data, Measures of Performance and their Estimation ,Output Analysis for Terminating Simulations, Output analysis for steady-State Simulations. Problems	3
8.	**UNIT - 8 -Verification, Calibration, and Validation; Optimization of simulation Models** : Model Building, Verification, Validation, Verification of simulation models, Calibration, Validation of models , Optimization, Optimization via Simulation	3
Total		33

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
3.	Midterm exam	Week 6	20%
4.	Quiz	Week 9	15%
3	Project	Week 11	15%
4	Final Exam	Week 12-13	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation. (Listed topics only from Chapters-1 to 12), 5th Edition, Pearson Education ©2013
Supportive References	• Averill M. Law: Simulation Modeling and Analysis , 4th Edition, Tata McGraw-Hill, 2007.ISBN : 9780070667334 • Lawrence M. Leemis, Stephen K. Park: Discrete – Event Simulation: A First Course,Pearson Education, 2006.ISBN: 978-0131429178
Electronic Materials	• ACM (Association for Computer Machinery) web site - http://www.acm.org/ • Open access course material online
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	A classroom or lecture hall with whiteboard for 35 students.
Technology equipment (projector, smart board, software)	● A classroom with high speed Internet connection ● A digital image projection system in the classroom that is connected to instructor desktop computer ● Has connection for laptop plug-in
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching		

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of students assessment	Faculty	Direct
Quality of learning resources	Peer Reviewer	Direct
The extent to which CLOs have been achieved	Faculty	Direct
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods(Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	Curriculum Committee Meeting
REFERENCE NO.	
DATE	15/10/2023