



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







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burse general I urpose of this cour nodeling. It provid s, and to implement ourse focuses on v ng simulations usin y's critical infrastru	Description rse is to introduce co es the foundations f it and test a variety o what is needed to bu ng pre-existing packa ucture networks. Bui	omputo or the of simu ild sim ages. In	er simulation student to ulation and o nulation soft ntroduce co Is to view ar	n techno understa data ana ware en ncepts o nd contro	logies and te nd computer lysis libraries vironments, a f modeling la ol simulation	chniques r simulatic and prog and not ju yers of s 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 control 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

Ð	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessn Method
	Knowledge and understa	inding		
	Describe the role of important elements of discrete event simulation and modeling paradigm.		LecturesDiscussions	-Homewor rubric -Midterm € -Final exaı
	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.		LecturesDiscussions	-Homewor rubric -Midterm ϵ -Final exai
	Skills			
	Interpret the model and apply the results to resolve critical issues in a real world environment.		LecturesDiscussions	-Homewor rubric -Midterm ϵ -Final exai
	Apply random numbers and variates to develop simulation models		LecturesDiscussions	-Homewor rubric -Quiz -Final exai
	Analyze output data produced by a model and test validity of the model		LecturesDiscussions	-Homewor rubric -Quiz -Final exai
	Explain the concepts of verification and validation		LecturesDiscussions	-Homewor rubric -Final exai
	Values, autonomy, and r	esponsibility		
	Ability to work independently collaboratively	V1	Assignments	-Homewor Rubric -Group p Rubric
	Abilitytomeetdeadlinesonassignmentsand	V1	Assignments	-Homewor Rubric -Group p





projects.			Rubric
C. Course Content			
l	ist of Topics		Contact F
UNIT – 1 Introduction : Wh when it is not appropriate, Ad Areas of application, Systems a system-Discrete and continu Models, Discrete-Event System The basics of SpreadSheet-S of queuing systems in a spread	en simulation is the vantages and disadva and system Environm lous systems, Model o m Simulation, Steps in imulation, Simulation dsheet	appropriate tool and ntages of Simulation, nent, Components of of a system, Types of n a Simulation Study, Example: Simulation	5
UNIT-2 -General Principle Discrete-Event Simulation, Algorithm, World Views Manu processing ,Basic pro Dynamic Allocation ,Linked Lis	s, Simulation Soft The Event-Schedulir al simulation Using Eventies, Operatio sts-Simulation in Java	ware : Concepts in ng / Time-Advance vent Scheduling ,List ns-Using Arrays, -Simulation in GPSS	5
UNIT 3- Statistical Models concepts, Useful statistical n Distributions, Poisson Process	in Simulation: Rev nodels, Discrete Distr , Empirical distribution	view of terminology, ributions ,Continuous s.	4
UNIT 4 - Queuing Models : Ch notation , Long-run measure Steady-state behavior of M/G modeling: An illustration	haracteristics of queuir es of performance of /1 queue, Networks of	ng Systems, Queuing of queuing Systems, of queues ,Rough-cut	4
UNIT 5- Random-Number Ge Properties of random number ,Techniques for generating Numbers, Random- technique ,Acceptance-Reject	neration, Random-Va s, Generation of pseu random numbers Variate Generation ,In ion technique, Specia	ariate Generation : udo-random numbers ,Tests for Random nverse transform al properties	6
UNIT 6 -Input Modeling: Data data, Parameter Estimation, stationary Poisson process ,S variate and Time-Series input	a Collection ,Identifyin Goodness of Fit T electing input models models	g the distribution with ests, Fitting a non- without data , Multi-	3
UNIT 7 –Estimation Of Abso Single Model : Types of sim Stochastic Nature of Output Estimation ,Output Analysis for for steady-State Simulations. F	Iute performance[Ou ulations with Respect Data, Measures of Pe r Terminating Simulat Problems	tput Analysis For A to Output analysis , erformance and their ions, Output analysis	3
UNIT - 8 -Verification, Calil simulation Models : Model B of simulation models, Calibra Optimization via Simulation	oration, and Validati uilding, Verification, V tion, Validation of m	on; Optimization of /alidation, Verification odels , Optimization,	3
	Total		33





No	Assessme	nt Activities *	Assessment timing (in week no)	Percentage of To 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%
	E. Learning Re	esources and Fac		project, essay, etc.)
	sential References	 Jerry Banks, David M. Ni (Listed topic Edition, Pea 	John S. Carson col: Discrete-Ev cs only from Ch rson Education	II, Barry L. Nelson, vent System Simula apters-1 to 12), 5th ©2013
Poportive References		 Averill M. La 4th Edition, : 978007066 Lawrence M Event Simul Education, 2 	aw: Simulation Tata McGraw-1 57334 1. Leemis, Steph ation: A First Co 2006.ISBN: 978-	Modeling and Anal Hill, 2007.ISBN nen K. Park: Discret Durse,Pearson -0131429178
		 ACM (Association of the state of th	ciation for Com /www.acm.org, s course materi	puter Machinery) v / al 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 instrudesktop computer Has connection for laptop plug-in





Other equipment None (depending on the nature of the specialty) F. Assessment of Course Quality sessment Areas/Issues Assessor Assessment Meth tiveness of teaching tiveness of students Faculty Direct ssment ty of learning resources Peer Reviewer Direct extent to which CLOs have Faculty Direct achieved r Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify) Assessment Methods(Direct, Indirect) G. Specification Approval Data





A. General information about the course:

1. Credit hours:	3					
2. Course type						
a. University 🗆	College	Department	\boxtimes	Track□	Others	
b. Required ⊠	Elective					
Level/year at w	hich this course	is				
 S. 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 						

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		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 understa	Inding		
1.1	Describe the role of important elements of discrete event simulation and modeling paradigm.		LecturesDiscussions	-Homework rubric -Midterm exam -Final exam
1.2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.		LecturesDiscussions	-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.		LecturesDiscussions	-Homework rubric -Midterm exam -Final exam
2.2	Apply random numbers and variates to develop simulation models		LecturesDiscussions	-Homework rubric -Quiz -Final exam
2.3	Analyze output data produced by a model and test validity of the model		LecturesDiscussions	-Homework rubric -Quiz -Final exam
2.4	Explain the concepts of verification and validation		LecturesDiscussions	-Homework rubric -Final exam
3.0	Values, autonomy, and r	esponsibility		
3.1	Ability to work independently and collaboratively	V1	Assignments	-Homework Rubric -Group project Rubric
3.2	Abilitytomeetdeadlinesonassignmentsandprojects.	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 , Multivariate 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

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

