هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	**Modeling and Simulation**
Course Code:	**MAT 1463**
Program:	**Bachelor of Science in Applied Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**08/10/2024**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
4 (3 Lectures, 1 Lab, 1 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Program	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 7 / Year 4					
4. Course general Description:					
The course introduces students to developing and analyzing mathematical models for real-world systems. It covers continuous systems using differential equations, partial differential equations, and discrete systems through difference equations. Students will also learn simulation techniques using MATLAB/Simulink, focusing on practical applications.					
5. Pre-requirements for this course (if any)**:**					
MAT 1334 Introduction to Partial Differential Equations					
6. Co-requisites for this course (if any)**:**					
None.					
7. Course Main Objective(s):					
The course is crucial in the Applied Mathematics program as it equips students with the skills to translate complex real-world problems into mathematical frameworks. This ability is essential for analyzing and solving issues across diverse fields such as physics, engineering, biology, and economics ...etc. By emphasizing both modeling techniques and simulation tools, the course fosters critical thinking and practical problem-solving skills, preparing students for careers in research, data analysis, and applied sciences. Ultimately, it enhances their capacity to make data-driven decisions and contributes to advancements in technology and innovation.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**60**	**100%**
2	E-learning	**0**	**0%**
3	Hybrid • Traditional classroom • E-learning	**0**	**0%**
4	Distance learning	**0**	**0%**

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	15
3.	**Field**	0
4.	**Tutorial**	15
5.	**Others (specify)**	0
Total		60

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	To formulate real problems in mathematical terms, making appropriate simplifying assumptions with description of advantages and limitation of Simulation approach.	K1, K2	●3 lecture hours\week ●1 tutorial hours\week ●1 lab hours\week ●Self-study	●Regular Exams ●Assignments
1.2	To use MATLAB and SIMULINK in the simulation techniques.	K1, K2		Assignments and lab exam Mini-project
2.0	**Skills**			
2.1	To develop techniques of problem solving.	S1, S2	●Self-study ●Real-life problems	Exams
2.2	To communicate mathematics clearly and precisely both orally and in writing.	S4		lab exam Mini-project Report and presentation
2.3	To communicate mathematics clearly and precisely both orally and in writing.	S5		

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	**Values, autonomy, and responsibility**			
3.1	To work individually.	V1, V3	Personal questions	Participation
3.2	To work in groups.	V1, V2	Team work	Mini-projects

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction to Mathematical Modeling Process:** Concept; Objectives; Methods and tools Mathematics is the natural modeling language; Definition of mathematical models.	**5**
2.	**Modeling Continuous Systems:** Modeling with Differential Equations: Population dynamic; Electrical Circuits; Mechanical Systems; Biological models (Lotka-Volterra systems, Predator-Prey systems).	**15**
3.	**Modeling with Partial Differential Equations:** Linear Temperature Diffusion; One-dimensional Hydrodynamic model. Case Studies: Heat diffusion, Wave vibration, Laplace Equation.	**15**
4.	**Modeling Discrete Systems:** Modeling with difference equations; Modeling with data; Discrete Velocity Models; Continuous Vs. Discrete Models	**10**
5.	**Simulation:** Block-Diagrams; State-Space Model; Transfer Functions, State-space Vs. transfer function. Stability and pole locations; Introduction to Matlab\Simulink (Starting Simulink, Basic Elements, building a System, Running Simulations); Simulation of some models (case study models) and Analysis of Simulation results.	**20**
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mini-project and participation	During the term	10%
2.	Midterm	Week 5-6	25%
3.	Lab Exam	Week 10-11	25%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
4.	Final Exam	Week 15-16	40%

*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	**Mathematical Modeling and Simulation: Introduction for Scientists and Engineers, Kai Veltn, Wiley 2009. (Main Reference 1)** **Introduction to Simulink® with Engineering Applications, Steven T. Karris, Orchard Publications, 2006. (Main Reference 2)**
Supportive References	**Simulation Modeling and Analysis with Expert fit Software, Averill Law, McGraw-Hill Science, 2007.** **A Concrete Approach to Mathematical Modelling, M. M. Gibbons, Wiley-Interscience, 2007.** **Topics in Industrial Mathematics; H. Neunzert, A. Siddiqui; Kluwer Academic Publishers, 2000.** **Mathematical Modeling Physical systems: An Introduction; D. Basmadjian, Oxford University Press, 2003.**
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms:** Equipped with whiteboards, projectors, and Smart Boards for interactive lessons and group discussions. • **Laboratories:** Feature computers with internet access, enabling hands-on activities and exploration of algebraic and trigonometric concepts. • **Exhibition Rooms:** Spaces for showcasing projects and presentations to encourage collaborative learning.
Technology equipment (projector, smart board, software)	• **Data Show Projectors:** For clear presentations in classrooms and labs. • **Smart Boards:** To enhance interactivity during lessons. • **Mathematical Software:** Essential for graphing and analysis.
Other equipment (depending on the nature of the specialty)	• **Computers:** For mini-project and homework and practical applications in laboratories. • **Advanced Calculators:** For computations and problem-solving and supporting the study of limits, continuity, and differentiation. • **Whiteboards and Markers:** To facilitate brainstorming and collaboration.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student and teaching staff	Surveys and Questionnaires
Effectiveness of Students assessment	Course Coordinator	Peer Reviews
Quality of learning resources	Students and teaching staff	Classroom Observations
The extent to which CLOs have been achieved	Student Representatives	Student Performance Evaluations (exams, projects) CLOs Excel sheet.
Other	None	

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL
REFERENCE NO.	8/1446
DATE	05/04/1446 (08/10/2024)