Lahore University of Management Sciences

EE 203: Engineering Models

Fall 2024

Personnel Details	
Lead Instructor	**Hassan Mohy-ud-Din, PhD**
Room No.	9-246, SBASSE Tesla Wing. Telephone Extension: 8505.
Office Hours	appointment by email (hassan.mohyuddin@lums.edu.pk)
Co-Instructors	**TBA** (), **TBA** (), and **TBA** ()
Co-Instructors' Office Hours	**TBA:** ---, **TBA:** ---, and **TBA:** ---
Course URL (if any)	LMS Site
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here: https://advising.lums.edu.pk/#supportservices

Course Offering Details					
Credit Hours	3				
Classes (per week)	2	Duration	75 min each	Timings & Venue	Tuesday & Thursday, 9:30 – 10:45 AM, SBASSE TBA
Recitation (per week)	None	Duration	NA		
Tutorial (per week)	None	Duration	NA		

Course Teaching Methodology				
Main Lectures	Mode	On-campus lectures (no recordings)	Duration (per week)	75 minutes (Tue & Thu)
Supplementary Lectures	Mode	Pre-recorded videos (if any)	Duration (occasionally)	varied
Student-specific Problem-solving Sessions	Mode	In-office OR Zoom	Duration (per week)	varied

Course Distribution	
Credit Hours	3
Core	Core
Elective	-
Open for Student Category	Sophomores
Closed for Student Category	-

Course Description
Engineering models allow Scientists and Engineers to understand systems under study by performing experiments. Differential equations have been the main tool (models) for the mathematical analysis, comprehension, design, and prediction of things that change. The emergence of digital computers has provided alternative methods for the approximate analysis for both natural and man-made systems through numerical solutions. This course describes both the analytical techniques for solving first order and second order differential equations as well as describes a wide range of unrelated physical phenomenon that can be modelled through them. In addition, graphical and numerical methods for solving differential equations are introduced. Furthermore, separable partial differential equations (PDEs) and their boundary value problems are introduced through the classical Heat, Wave and Laplace's equations.

Course Prerequisite(s)/Co-Requisite(s)	
Pre-requisites	MATH-101 Calculus I
Ante-requisites	MATH 210 Introduction to Differential Equations
Recommended	MATLAB (basic understanding)

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Assessed Course Learning Outcomes	
EE – 203	The students should be able to:
CLO1:	Comprehend basic modeling and simulation concepts and their applications to engineering solutions.
CLO2:	Solve first-order and higher-order linear differential equations.
CLO3:	Model with first-order and higher-order differential equations.
CLO4:	Have a basic appreciation of numerical methods for solving ordinary differential equations.
CLO5:	Solve partial differential equations subject to boundary conditions specifically heat equation, wave equation, and Laplace's equation.

Relation to EE Program Outcomes				
EE-203 CLOs	Related PLOs	Levels of Learning	Teaching Methods	CLO Attainment checked in
CLO1	PLO7	Cog-2	Instruction, Homework	Midterm, Project
CLO2	PLO2	Cog-3	Instruction, Homework	Midterm, Final
CLO3	PLO1	Cog-5	Instruction, Homework	Midterm, Final
CLO4	PLO5	Cog-3	Instruction, Homework	Final
CLO5	PLO2	Cog-3	Instruction, Homework	Midterm, Final

Grading Breakup and Policy		
Class quizzes	25%	N-3 policy on quizzes (at least 10 in total). Minimum 7 quizzes will count towards grade.
Assignments/Tutorials	5%	To-be-decided in class
Modeling Project	10%	One modeling problem; can be posed a project
Midterm exam	30%	Combined and closed book
Final exam	30%	Combined and closed book

Examination Detail	
Midterm Exam	**Yes/No:** Yes **Combine/Separate:** combined **Duration:** 2 – 3 hours **Preferred Date:** early in the mid-term week **Exam Specifications:** closed book, closed notes, no help sheets, all relevant formulas will be provided in the question paper.
Final Exam	**Yes/No:** Yes **Combine/Separate:** combined **Duration:** 3 hours **Exam Specifications:** closed book, closed notes, no help sheets, all relevant formulas will be provided in the question paper.

Campus Support and Key University Policies

Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources, etc. To view all support services, their specific role as well as contact information click here.

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity and 2) Understanding and Avoiding Plagiarism.

LUMS Academic Accommodations/Petitions Policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or "Petition" FAQs for students and faculty at https://rb.gy/8sj1h.

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LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated. To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. For more information: *Harassment, Bullying & Other Interpersonal Misconduct: Presentation*.

SSE Council on Equity and Belonging

In addition to LUMS resources, SSE's Council on Belonging and Equity is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk.

Rights and Code of Conduct for Online Teaching

The misuse of online modes of communication is unacceptable. TAs and Faculty will seek consent before the recording of live online lectures or tutorials. Please ensure, if you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, LMS) over informal means to communicate with course staff. Kindly follow the copyright rules attached with the educational materials uploaded on LMS by the instructor.

Course Overview

Week No.	Book Chapter or References	Topic	Related CLOs & Additional Remarks
1 – 2	1.1 – 1.6 (**IMS**), Class Notes	Modelling & Simulation: Basic Concepts Systems and Experiments, The Model Concept, Simulation, Building and Analyzing Models, Types of Models and their use for developing sustainable solutions.	CLO1
3 – 5	2.1 – 2.5 (**DE**), Class Notes	First order differential equations, Direction Fields, Separable variables, Linear Equations, Exact Equations, Substitutions	CLO2
6	3.1 – 3.3 (**DE**), Class Notes	Modeling with First Order Differential Equations Linear Equations, Non-Linear Equations, Systems of Linear Equations	CLO3
7 – 10	4.1 – 4.4 (**DE**), 4.6 – 4.8 (**DE**), Class Notes	Second order linear differential equations, Initial value and boundary value problems, Linear Dependence, Wronskian, Reduction of order Homogeneous equations, Characteristic equations, Non-homogeneous equations, Method of undetermined coefficients Method, Variation of Parameters, Cauchy Euler Equations, Solving systems of DEs by Elimination.	CLO2
-	-	**Mid Term Exam**	-
11	5.1 (**DE**), Class Notes	Modeling with Higher-Order Differential Equations Linear Equations: Initial Value Problems – Mechanical and Electrical Systems, Linear Equations.	CLO3
12 – 13	12.1 – 12.5 (**DE**), Class Notes	Partial Differential Equations (PDEs) and Boundary Value Problems in Rectangular Coordinates. Separable PDEs, Classical Equations and Boundary Value Problems – Heat Equation, Wave Equation and Laplace's Equation. Non-Homogeneous boundary value problems.	CLO5
14	9.1 – 9.3 (**DE**), Class Notes	Numerical Methods for Ordinary Differential Equations, Euler Methods, Runge-Kutta Methods, Multistep Methods	CLO4
-	-	**Final Exam**	-

Textbook(s)/Supplementary Readings

Textbook(s):

- G. Zill & M. R. Cullen, **(DE)**, **Differential Equations with Boundary-Value Problems**, 7th edition, Cengage Learning, (2008).
- P. Fritzson **(IMS)**, **Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica**, IEEE Press and John Wiley, (2011).
- W. J. Palm, **Introduction to MATLAB 7 for Engineers**, (2005).

Reference(s):

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- P. Fritzson, **Principles of Object-Oriented Modeling and Simulation with Modelica**, IEEE Press and John Willey, (2004).
- W. E. Boyce & R. C. Diprima, **Elementary Differential Equations and Boundary Value Problems**, 8th edition, John Wiley & Sons, (2004).
- M. Tiller, **Introduction to Physical Modelling with Modelica**, Kluwer Academic Publishers, (2001).

Prepared and revised by:	**Dr. Hassan Mohy-ud-Din**
Revision Date:	**July 15, 2024**