Lahore University of Management

MATH 210 – Introduction to Differential Equations
Fall 2023-2024

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Course URL (if any)	www.lms.lums.edu.pk

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 min
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution	
Core	Core for math majors
Elective	
Open for Student Category	All students
Close for Student Category	None

COURSE DESCRIPTION
Differential equations (DEs) involve derivatives of functions. Differential equations have remained at the forefront of various disciplines including applied mathematics, physics, engineering, chemistry, biology, economics and social sciences. These equations enable a natural, physical and social phenomena to be expressed in the language of mathematics and provide useful information about the phenomena. The study of these equations and their solutions is therefore important. This course deals with: First order differential equations; modeling; second order linear equations; Damped motion in mechanical and electrical systems; System of first order linear equations; Eigenvalues and Eigenvectors; Series solutions; Introduction to special functions; Fourier series; Partial differential equations; separation of variables and Sturm-Liouville problems.

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COURSE PREREQUISITE(S)

• • •	MATH 120 & Anti-req: EE 203

COURSE OBJECTIVES

	Students will be trained to:
• • •	Solve differential equations by suitable methods Apply differential equations to real- world problems. Analyze solutions of differential equations

Learning Outcomes

• • • • • • • •	Students will learn to: Solve differential equations using suitable methods. Apply mathematics to problems in social, physical and engineering sciences etc. Formulate first order ordinary differential equations for modelling of population dynamics and Mechanics etc. Formulate second order differential equations to model physical problems involving damped motion in mechanical electrical system. Find Series solutions of higher order linear differential equations. Solve systems of first order linear equations by using matrix algebra. Use method of separation of variables for solutions of PDEs.

Grading Breakup and Policy

Assignments: 10%
Class
Participation:
Attendance:
Midterm Examination:
40%Project:
Final Examination: 50%

Examination Detail	
Midterm Exam	Yes/No: Yes Combine/Separate: Duration: TBA Exam Specifications: No notes/No books/No calculators
Final Exam	Yes/No: Yes Combine Separate: Duration: TBA Exam Specifications: No notes/No books/No calculators

COURSE OVERVIEW			

Week	Topics	Recommended Readings	Objectives/Application
1	First order differential equations Preliminaries Separable variab		**Solutions of differential equations**

	les Exact Equations		
2	Homogeneous Equations Linear equations Integrating factors		**Solutions of differential equations**
3	Some nonlinear first order equations with known solution Modeling Exponential growth' and decay, Half life Newton's law of cooling, series circuits		**Solutions of differential equationsModeling of real-world systems**

4	Second order linear differential equations Initial value and boundary value problems Homogeneous equations Characteristic equations Complex roots, repeated roots; reduction of order		**Solutions of differential equations**
5	Non-homogeneous equations Undetermined coefficients Method Wronskian, Particular Solution		**Solutions of differential equations**
6	Modeling Damped motion in mechanical and electrical		**Modeling of real-world systems**

	systems		
7	System of first order Linear equations Introduction, Review of matrices, linear independence Eigen values, Eigen vectors		**Solutions of differential equations**
8	Basic theory of systems of first order linearequations, Homogeneous linear system with constant coefficients		**Solutions of differential equations**
9	Complex Eigen values, repeated Eigen values,Non homogeneous linear system Series Solutions Power series		**Solutions of differential equations**
10	Series solutions near an ordinary point, Classification of singular points Frobenius theorem		**Solutions of differential equations**
11	Frobenius theorem (Continue) , Introduction tospecial functions Partial Differential equations and Fourier seriesTwo point boundary value problems, Fourier series		**Solutions of differential equations**
12	The Fourier convergence theorem, even andodd functions Separation of variables and partial differential equations		**Solutions of differential equations**
13	Separation of variables and partial differentialequations (Continue) Sturm-Liouville problems		**Solutions of differential equations**
	Sturm-Liouville problems (Continue)		**Solutions of differential equations**

Textbook(s)/Supplementary Readings
There is no required text but the following texts will be used for reference.   1) Differential equations with boundary-value problems by Dennis G. Zill and Michael R. Cullin (7th Edition Brooks/Cole)   2) Elementary differential equations and boundary value problems by William E. Boyce and Richard C. Diprima. (Seventh Edition John Wiley& Sons, Inc.)