King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics
SYLLABUS
Semester II: 2018-2019 **(182)**

Instructor: Dr. A. Bonfoh
Course #: MATH 435
Title: Ordinary Differential Equations

Textbook: The qualitative theory of ordinary diffential equations: an introduction. By F. Brauer and J. A. Nohel, Dover Publications, Inc. NY (1969).

Objectives: The course aims to introduce basic concepts of existence, uniqueness, asymptotic behavior and stability of solutions to ordinary differential equations.

Course description: First order scalar differential equations. Initial value problems. Existence, uniqueness, continuous dependence on initial data. Linear systems with constant coefficients. The exponential matrix. Asymptotic behavior of linear and almost linear systems. Two dimensional autonomous systems. Critical points and their classifications. Phase plane analysis. Introduction to the theory of Lyapunov stability..

Prerequisites: MATH 202 and MATH 225, or MATH 208.

Learning outcomes: Upon successful completion of this course, a student should be able to:

- Solve 1st order linear systems with constant coefficients.
- Prove existence, uniqueness and continuation of solutions to 1st order systems.
- Analyze the asymptotic behavior of solutions to linear systems.
- Obtain phase portrait of 2-dimensional autonomous systems.
- Prove stability of linear and almost linear systems: perturbation method, Lyapunov's second method.

Week	Date	Sec.	Topics	Suggested Homework Problems
1	Jan 6 – 10	1.1 1.2	A single Mass-Spring System Coupled Mass-Spring Systems	
2	Jan 13 – 17	1.3 1.6	Systems of First-Order Equations Existence, Uniqueness, and Continuity	
3	Jan 20--24	1.7	The Gronwall Inequality Exercise Session	
4	Jan 27–31	2.2 2.3 2.4	Existence and Uniqueness for Linear Systems Linear Homogeneous Systems Linear Nonhomogeneous Systems	
5	Feb 3 – 7	2.5	Linear Systems with Constant Coefficients	
6	Feb 10–14	2.6 2.7	Similarity of Matrices and the Jordan Canonical Form Asymptotic Behavior of Solutions of Linear Systems with Constant Coefficients	
First Exam: Wednesday, February 20, 2019 [1.1-2.5]				

7	Feb 17 – 21	2.8 2.9	Autonomous Systems — Phase Space ---Two-Dimensional Systems Linear Systems with Periodic Coefficients	
8	Feb 24 – 28	3.1	Existence in the Scalar Case Exercise Session	
9	March 3 – 7	3.2 3.3	Existence Theory for Systems of First-Order Equations Uniqueness of Solutions	
10	March 10 – 14	3.4 3.5	Continuation of Solutions Dependence on Initial Conditions and Parameters	
11	March 17 – 21	4.2 4.3	Definitions of Stability Linear Systems	
12	March 24 – 28	4.4 4.5	Almost Linear Systems Conditional Stability	
Second Exam: Wednesday, March 27, 2019 [2.6-2.9 & 3.1-3.5]				
13	March 31 – April 4	4.6 4.7	Asymptotic Equivalence Stability of Periodic Solutions	
14	April 7 – 11	5.2 5.3	Lyapunov's Theorems Proofs of Lyapunov's Theorems	
15	April 14 – 18	5.4 5.5	Invariant Sets and Stability The Extent of Asymptotic Stability --- Global Asymptotic Stability	
Final Exam: Saturday, April 27, 2019 [comprehensive]				

Grading:

Exam I, II	20% each
Homework assignments	20%
Presentations	10%
Final Exam	30%