King Fahd University of Petroleum and Minerals
Department of Mathematics
SYLLABUS
Semester I: 2022-2023**(222)**

Instructor: Dr. A. Bonfoh
Course: **MATH 665:** Advanced Ordinary Differential Equations II

Objectives: This course reinforces students ability to understand, solve and deal with linear and nonlinear ordinary differential equations. The course extends the knowledge acquired in Math565 to the notions of bifurcation, self-adjoint and non self-adjoint Sturm Liouville BVPs, and also oscillation and comparison theorems.

Course Description: Self-adjoint boundary-value problems, Sturm-Liouville theory. Oscillation and comparison theorems. Asymptotic behavior of solutions. Singular Sturm-Liouville problems and non self-adjoint problems. Hypergeometric functions and related special functions. Bifurcation phenomena.

Prerequisite: MATH565.

Credit: 3 credit hours

References:
1.The qualitative theory of ordinary diffential equations: an introduction. By F. Brauer and J. A. Nohel, Dover Publications, Inc. NY (1969).
2.Nonlinear Differential Equations and Dynamical Systems by F. Verhulst (Second Edition, 1996. Revised 2006)
3. Russell L. Herman. A Second Course in Ordinary. Differential Equations: Dynamical Systems and. Boundary Value Problems. Monograph, 2008.

Week		Topics	
1-12		Invariant sets and stability Center manifolds and stability Bifurcation Theory Self-adjoint operators and examples The case of Sturm-Liouville operator The regular self-adjoint Sturm-Liouville eigenvalue BVPs Special functions Green's functions The singular non self-adjoint Sturm-Liouville eigenvalue BVPs Oscillations and Comparison theorems The Fredholm Alternative Theorem	
13-15		Presentations of mini research projects	

Grading:

Midterm Exam	35%
Homework assignments	20%
Presentation	10%
Final Exam	35%