King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics
SYLLABUS
Semester I: 2021-2022**(211)**

Instructor: Dr. A. Bonfoh
Course #: MATH 695 Reading and Research I
Title: Infinite-dimensional Dynamical Systems

Objectives: This course is designed to prepare students to take up research in the area of infinite-dimensional dynamical systems with applications to nonlinear PDEs.

Course Description: The course will cover existence and uniqueness of solutions, Semigroups, limits sets, existence of the global attractor. As typical examples, attractors for reaction-diffusion equations, Navier-Stokes equations, the Cahn-Hilliard equation and the phase-field system will be studied.

Credit: 3 credit hours

Textbook: J.C. Robinson, *Infinite-dimensional Dynamical systems*, Cambridge University Press, Cambridge, 2001

Papers to read :
1.Large time behavior of a conserved phase-field system, by A. Bonfoh and C. Enyi (2016).
2.On Cahn-Hilliard-Gurtin equations, by A. Bonfoh and A.Miranville (2001).
3.Global Attractors of Sixth Order PDEs Describing the Faceting of Growing Surfaces, by M. Korzec et al. (2016).

Week	Date	Sec.	Topics	Suggested Homework Problems
1			Some nonlinear analysis tools	
2		8.1 8.2 8.3 8.4	Nonlinear Reaction-Diffusion Equation (NRDE) The Basis for the Galerkin Expansion Weak solutions of the NRDE Strong solutions of the NRDE	
3-4		9.1 9.2 9.3 9.4 9.5 9.6	The Stokes operator The weak form of the Navier Stokes equation Properties of the Trilinear form Existence of weak solutions Unique solution in 2d Existence of strong solutions in 2d	
5-6		10.1 10.2 10.3 10.4 10.5 10.6	Semigroups Dissipation Limits sets and attractors A theorem for the existence of global attractors An example- The Lorenz attractor Structure of the attractor	
7-8		11.1	Reaction-Diffusion Equation- Absorbing sets and the attractor	

		11.2 11.4 11.5	Regularity results A Lyapunov functional The Chaffee-Infante equation	
9-10		12.1	Attractors for 2d Navier-Stokes equation	
11-15			Reading of the above-mentioned papers (with a focus on the Cahn-Hilliard equation and phase-field systems)	

Overlap with regular courses: less than 5%

Grading:

Midterm	30%
Homework assignments	30%
Presentation	10%
Final Exam	30%