Special Topics Course MATH 689
Nonlinear Functional Analysis and Applications

Instructor: Edriss S. Titi **Email:** titi@math.tamu.edu

Title: Nonlinear Functional Analysis and Applications.

Course description: In these self contained lectures I will introduce and develop some of the basic analytical tools in nonlinear functional analysis. The main focus will be on the implementation of these methods in investigating and solving certain nonlinear problems, with emphasize on nonlinear partial differential equations. The course will be useful to all students with interest in nonlinear analysis, differential geometry and applied and computational mathematics.

Background: Students are expected to know Real Analysis.

Proposed topics to be covered:

1. Review of Basic Function Spaces.
2. Some Fixed Point Theorems.
3. Galerkin Method.
4. Monotone Iterations and Monotone Operators.
5. Differential and Integral Calculus in Banach Spaces.
6. Variational Methods.
7. Palais-Smale Condition and Moutain Pass Lemma.
8. Pohozaev's Identity.

Further topics for supervised studies:

1. Brouwer Degree.
2. Leray-Schauder Degree and Applications.

3. Bifurcation Theory.

Literature:

1. E. Zeidler, *Nonlinear Functional Analysis and its Applications, Parts I, II, III.* Springer–Verlag.
2. S. Kesavan, *Nonlinear Functional Analysis and its Applications: A First Course.* Hindustan Book Agency (India), 2004.
3. Additional various sources from the mathematical literature.

Evaluation: Students will be evaluated based on attendance (at least 80% of the classes), homework (couple of problems will be assigned occasionally during the class, which will add up to 4-6 homework assignments). Students are expected to dedicate 3–4 hours, in the average, weekly for this course.