Texas Tech University, Department of Mathematics and Statistics

COURSE SERIES ANNOUNCEMENT

TOPICS IN NUMERICAL ANALYSIS I-II

MATH 5344-5345, Fall 2021-Spring 2022

Instructor: Dr. Giorgio Bornia (giorgio.bornia@ttu.edu)
http://www.math.ttu.edu/∼gbornia

This course series provides the students with the necessary ingredients to perform research in the areas of

- **Numerical Analysis of Partial Differential Equations**;
- **Scientific Computing**.

It is addressed to all graduate students in *both pure and applied mathematics*, *engineering* and *science*.

General description

- **Partial Differential Equations** (PDEs) are a privileged mathematical tool for the description of real-life phenomena in several fields. Far from being exhaustive, one can mention fluid dynamics, structural mechanics, electromagnetism, chemistry and biology.
- In the vast majority of real-life applications, no analytical methods are known and one can only obtain *approximate solutions* to PDEs. The study of algorithms to determine such approximations is the fundamental question of **Numerical Analysis**. Attention must be paid to both accuracy and computational complexity.
- The *implementation* of these procedures via efficient programming languages is the core subject of **Scientific Computing**.

Expected Student Learning Outcomes

Students will learn to

- formulate **numerical discretizations** of PDEs;
- analyze **finite element approximations** and their theoretical convergence properties;
- implement algorithms using cutting-edge **open-source software**;
- become familiar with **Linux**-based operating systems and with the **C/C++** languages.
- perform **software development** in a collaborative way using version control systems.

Emphasis will be given to both **theoretical** and **practical** aspects. Students will be guided in a hands-on approach to the solution of challenging numerical problems with advanced algorithms, presented in conjunction with theoretical results.

To this end, classes will be held in the **Computer Lab** in room MATH 113, on a Tuesday-Thursday schedule, 2-3:20 pm.

Prerequisites

A basic exposure to differential equations, numerical analysis and computer programming is assumed.

The instructor will strive to present the material in self-contained fashion.

Assessment of Learning Outcomes

Attendance is mandatory. The exam consists of the oral **presentation** of an **individual project** related to the course material, to be decided together with the instructor.

Homework assignments will be given in order to gain familiarity with the presented topics.