MAP7437: SEM IN APPLIED MATH 2
MWF Period 5 (11:45am - 12:35 pm) Room: MWF, Little Hall 205

Instructor: Cheng Yu, Little Hall 416, chengyu@ufl.edu

Office Hours: MW 9:40am-10:40am.

Textbook and Reference:
1. Partial Differential Equations by Evans,
2. Relative entropy and the stability of shocks and contact discontinuities for systems of conservation laws with non-BV perturbations by Legar and Vasseur, Arch. Ration. Mech. Anal. 201 (2011), no. 1, 271–302.
3. Relative entropy and contraction for extremal shocks of conservation laws up to a shift by Vasseur, Recent advances in partial differential equations and applications, 385–404, Contemp. Math., 666, Amer. Math. Soc., Providence, RI, 2016.
4. The Euler equations as a differential inclusion, by De Lellis, and Székelyhidi, Ann. of Math. (2) 170 (2009), no. 3, 1417–1436.
5. The h-principle and the equations of fluid dynamics, by De Lellis, and Székelyhidi, Bull. Amer. Math. Soc. (N.S.) 49 (2012), no. 3, 347–375.
6. Global ill-posedness of the isentropic system of gas dynamics, by Chiodaroli, De Lellis and Kreml, Comm. Pure Appl. Math. 68 (2015), no. 7, 1157–1190.
7. Non-uniqueness of admissible weak solutions to the Riemann problem for isentropic Euler equations, by Chiodaroli, and Kreml, Nonlinearity 31 (2018), no. 4, 1441–1460.
8. Uniqueness of solutions to hyperbolic conservation laws, by DiPerna, Indiana Univ. Math. J. 28 (1979), no. 1, 137–188.

Prerequisites: any graduate, advanced undergraduate students. I will make the course appealing and accessible to all students with background of advanced calculus and linear algebra.

Description: "It is generally accepted that the conservation laws (or first integrals) of the classical dynamical systems are always of mathematical importance and at the same time, they are regarded as the manifestation of some profound physical principle." There are many fundamental equations in science and engineering, such as the Maxwell equations of electromagnetics, the Euler and Navier-Stokes equations of fluid dynamics and equations of elasticity and the systems of magnetohydrodynamics of plasma physics, can be viewed as the system of conservation laws. Note that, the system of conservation laws are still important subjects of mathematical study.

In this course, we shall develop our understanding to the PDEs in the conservation laws. We shall begin to discussing basic problems of conservation laws, such as shocks, entropy conditions, discontinuous initial data, Riemann problem.Then we shall introduce a new fundamental tool-convex integration. This tool is vey popular in PDE community during the past 10 years, since it was used to solve several important conjectures and big open problems in fluid equations, like Onsager's conjecture and the nonuniqueness of solutions to the Navier-Stokes equations. The third part of this course is to study the system of conservation laws by convex integration.

In one word, this course is designed for the graduate students from math and Engineering. There are three parts of this course: introduction to the conservation laws, introduction to the convex integration and using convex integration to study the conservation laws.

Exams: The grade will be determined by a final project and presentations in class.

Extra Help: Please stop by my office during office hours or by appointment to discuss any aspect of the course. Welcome students to discuss any research problems on nonlinear PDEs.