- **Course Number and Title:** M E 510. Special Topics: Nonlinear and Optimal Control
- **Catalog Description:** Introduction to nonlinear systems and optimal control theory and its mathematical foundations. Includes equilibrium finding, phase plane analysis, Lyapunov stability theorems, feedback linearization, Pontryagin's maximum principle, necessary conditions and sufficient conditions for optimality, and optimal control problems in mechanical and aerospace engineering.
- **Credit Hours:** 3 Credits (3)
- **Prerequisite(s) / Corequisite(s)** Prerequisite(s): M E 527 or A E 527 or Consent of Instructor
  Corequisite(s): None
- **Required:** Graduate Elective
- **Course Availability:** N/A
- **Instructor (Usual):** N/A
- **Textbook:**
  1) A D. Kirk, *Optimal Control Theory*, An Introduction, Dover Publication, Inc. 1970
  2) H. Khalil, *Nonlinear Systems*, 3rd Edition, Pearson, 2001
- **Course Learning Objectives:** <u>After completing this course, a student should be able to:</u>
  1) Analyze the stability and performance properties of nonlinear systems and design nonlinear feedback control systems;
  2) Use optimal control theory and numerical optimization methods to solve engineering problems;
  3) Design and simulate nonlinear and optimal control systems for mechanical and aerospace engineering applications.
- **Topics Covered:**
  - Phase plane analysis
  - Lyapunov stability theorems
  - Feedback linearization
  - Calculus of variations
  - Pontryagin's maximum principle
  - Necessary conditions and sufficient conditions for optimality
  - Continuous-time optimal control problems
  - Numerical optimization methods.