1. **MEEG332 FLUID MECHANICS II**

2. **Credits 3 Contact Hours 3**

3. **Spring 2017** Dr. Joseph P. Feser, Spencer Lab

4. **Textbook** "Fluid Mechanics" 8th Edition, F.M. White , McGraw-Hill, 2016

5. **Specific course information**

   a. **Catalog Description:** Compressible flows, isentropic flow, shock waves; lift and drag; inviscid flows, potential and stream functions, elementary wing theory; boundary layers; computational fluid dynamics.
   b. **Prerequisite:** MEEG331 (Fluid Mechanics I) and MATH352 (Engineering Mathematics II)
   c. **Course is required.**

6. **Specific goals for the course**

   a. **Specific Outcomes of Instruction:** This second of the two required courses in fluid mechanics is designed to familiarize the student with complicated physical phenomena that are routinely associated with the flow of fluids. The students are made particularly aware of the fundamental divisions in the science and engineering of fluid flow; they are expected to appreciate, and be able to apply in later design, concepts of compressible v. incompressible fluid, laminar v. turbulent flow, and internal v. external flow. The emphasis is on flow in pipes and boundary layers, and 2-D potential flow.

   By the end of the course, each student should be able to:
   - Find speed and pressure distribution around simple 2D bodies in ideal fluid flow
   - Construct ideal flow solutions using singularities
   - Determine size of pipe and pumping requirements for viscous flow problems
   - Solve laminar and turbulent Boundary Layer flow problems
   - Set up, and solve, rate dependent models for simple drag problems
   - Use charts and models to solve lift/drag around airfoils and wings.
   - Use charts and equations for 1-D gas flow (isentropic and shock wave analyses)
   - Write computer codes to solve and visualize complex fluid mechanics problems.

   b. **Student Outcomes Addressed:**
   Can address Outcomes a, e, and k; also part of ME Program Criteria. However, for Spring 2017 no specific outcomes aligned with MEEG332.

7. Brief list of topics to be covered

- Flow of an incompressible inviscid fluid. Stream function and velocity-potential; elementary plane-flow solutions; superposition of elementary solutions; functions of a complex variable, the Rankine oval; flow past a circular cylinder with circulation; Kutta-Joukowski theorem; finite-difference approximation; conformal mapping; Joukowski transformation.
- Boundary layer (BL) flows. matching of BL and potential flows. internal versus external flow; momentum relations for BL flows; BL thickness; the BL equations, adverse pressure gradient, separation; the turbulent BL; aerodynamic forces; forces on lifting bodies.
- Viscous flow in ducts. Laminar and turbulent flows; flow in pipes, dimensional analysis, friction factor; exact solution for a circular pipe; time averaged turbulent flow;Moody chart; types of generic pipe-flow problems; flow in noncircular ducts using hydraulic diameter; minor losses in pipe systems; experimental flow measurement techiniques.
- Computational Fluid Dynamics. Finite difference technique; conformal mapping; Integrated use of coding in assignments (usage of ODE solvers, numerical integrators, numerical root finding); flow visualization (streamlines, quiver plots, contour maps).
- Flow of compressible fluids. The speed of sound, Mach number; adiabatic and isentropic steady flow; isentropic flow with area change; normal shock; the converging- diverging nozzle.