Fluid Mechanics 335 – Course Objectives

1. In all problems worked this semester, students will **report, carry, and cancel units**, to check their work and to reinforce their understanding of the fundamental components of the properties or variables they are working with.

2. Students will describe and employ the definitions of such **fluid properties** as mass density, specific weight, specific gravity, viscosity, surface tension, elasticity, vapor pressure and specific heat, and be able to build on these definitions for the rest of the course.

3. For fluids at rest, students will understand and calculate how pressure varies with depth, how **hydrostatic forces** vary on submerged faces, why some objects sink and others float, and the factors influencing stability of a floating or immersed body; students will be able to apply equations to predict how hydrostatic forces will act.

4. Students will be able to employ, sketch and describe the **control volume** approach and the principle of the **conservation of mass** in solving problems; they will understand how these are used to develop the **continuity equation**. Students will understand how the continuity equation requires conservation of mass in different cross-sections of or at different velocities, and will be able to solve problems based upon those principles.

5. Students will understand that **fluids move** in response to differences in pressure: students will be able to describe and calculate how differences in pressure can be caused by elevation (weight); pumps; acceleration or deceleration, or by viscous resistance. Students will understand the **Bernoulli Equation** and be able to solve problems with computations or sketches for many situations, including pitot tubes and flownets.

6. Students will review the concept of **momentum,** and will understand how changes in the momentum of fluid are related to forces. Students will understand the **Navier-Stokes Equation** and understand that it relates changes of momentum (acceleration) to shear stresses, gravity and other forces, velocity and pressure; students will be able to solve problems relating momentum, velocity, pressure, and shear stress.

7. Students will understand that the **energy equation** combines the effects of mechanical forces (pressure, gravity and shear stress) with heat. They will be able to construct energy grade lines and hydraulic grade lines, and solve other problems wherein energy is transformed among heat, pressure, friction losses, etc.

8. Students will understand the principles of **dimensional analysis** and **similitude**, and be able to calculate values of use such numbers as the **Froude number, the Mach number, Reynold's number** to make general conclusions about modes of fluid motion.

9. Students will be able to summarize and describe the importance of **surface resistance and boundary layers** to a myriad of practical situations. Students will understand why a **velocity profile** exists for a flowing Newtonian fluid, and be able to sketch shear stress as a function of position in a tube.

10. Students will be able to describe how pressure, velocity, shear stress and momentum affect **flow in pipes**, and will be able to calculate energy losses due to roughness, diameter changes, direction changes, etc.

11. Students will be able to describe that **drag and lift** are forces produced by the dynamic action of flowing fluid (unlike buoyant and weight forces), and will be able to calculate drag and lift for certain geometries.

12. Students will be able to describe how **open-channel** flow is different from closed-conduit flow, and will be able to calculate specific energy, critical flow, and critical depth. Students will understand how a hydraulic jump occurs.