Course  ME 31900 – Fluid Mechanics Laboratory
Cross-listed Course  CE 31900 – Fluid Mechanics Laboratory
Type of Course  Required for ME program
Catalog Description  Introduction to fluid mechanics laboratory and design of experiments, including experiments on flow patterns, velocity profile in an air pipe, wind tunnel calibration, draining of a tank, pipe friction, drag forces, boundary-layer studies, falling-ball experiments, and measurements of fluid properties.
Credits  1
Contact Hours  3
Prerequisite Courses  ME 29300 and ME 31800
Corequisite Courses  None
Prerequisites by Topics  Measurements and Instrumentation, Fluid Mechanics
Course Objectives  This lab has four objectives: 1) To compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows; 2) to discuss and practice standard measurement techniques of fluid mechanics and their applications; 3) to learn and practice writing technical reports; and 4) to work on small design projects.
Course Outcomes  Students who successfully complete this course will have demonstrated an ability to:
1. Identify, name, and characterize flow patterns and regimes. (a, 1)
2. Understand basic units of measurement, convert units, and appreciate their magnitudes. (a, 1)
3. Utilize basic measurement techniques of fluid mechanics. (a, 1)
4. Discuss the differences among measurement techniques, their relevance and applications. (h, i, 9)
5. Measure fluid pressure and relate it to flow velocity. (k, 6)
6. Demonstrate practical understanding of the various equations.
of Bernoulli. (k, 6)
7. Demonstrate practical understanding of friction losses in internal flows. (k, 6)
8. Demonstrate practical understanding of boundary layers, separation, drag, and lift. (k, 6)
9. Demonstrate the ability to write clear lab reports. (g, 8)
10. Use word processors, graphics packages, and computational software in writing. (g, i, 8, 9)
11. Prove good understanding of concepts and their applications in the laboratory. (a, g, 1, 8)
12. Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions. (a, k, 1, 6)
13. Demonstrate the ability to work in groups on small design projects that are appropriate to the course. (d, g, 5, 8)
14. Demonstrate the ability to produce a working model through hands-on experience in fluid mechanics design and explain its operation in terms of what was learned in the course. (a, b, c, e, g, 1, 3, 4, 2, 8)
15. Understand ethical issues associated with decision making and professional conduct. (f)

**Laboratory Topics**

1. Mass density of liquid water
2. Stokes Law and measurement of viscosity
3. The law of hydrostatics: pressure variation in a fluid at rest
4. Hydrostatic forces on submerged surfaces
5. Fluids in rigid-body rotation: forced vortex
6. Bernoulli’s equation in the draining of a cylindrical tank: the free vortex
7. Calibration of a wind tunnel: an application of Bernoulli’s equation
8. Impact of a jet on stationary vanes: linear momentum
9. Flow of air in a convergent-divergent channel: contraction and expansion losses
10. Flow in circular tubes of various diameters
11. Influence of pipe length & diameter on the draining of a tank
12. Demonstration of open-channel flow phenomena
13. Flow past a circular cylinder: pressure and drag coefficients; the viscous wake
14. Estimation of boundary-layer growth on a flat plate in a wind tunnel
15. Drag forces on an oscillating pendulum
16. Drag forces on golf balls: the effect of dimples
17. Design of experiments: exploration of dripping flows

**Computer Usage**

- High
<table>
<thead>
<tr>
<th>Laboratory Experience</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Experience</td>
<td>High</td>
</tr>
<tr>
<td>Coordinator</td>
<td>Josué Njock Libii, Ph.D.</td>
</tr>
<tr>
<td>Date</td>
<td>31 March 2011</td>
</tr>
</tbody>
</table>