Course alpha, number, title

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ME 332 Fluid Mechanics

Required or elective
Required

Course (catalog) description
Statics, control volume equations, similitude, and exact fluid solutions. Turbulence, pipe flow, boundary layer flow, compressible flow, and Navier-Stokes equations.

Prerequisite(s)
ME 361 and (CHE 321 or ME 201) and ((ME 391 or concurrently) and completion of Tier I Writing requirement).

Textbook(s) and/or other required material

Class/Lab schedule:
Total Credits: 4 Lecture/Laboratory/Discussion Hours: 3/3/0

Topics covered
(a) Fluid Statics
(b) Bernoulli Equation
(c) Fluid Motion
(d) Conservation of Mass Equation (Control Volume Form, CV)
(e) Momentum Equation (CV)
(f) Energy Equation (CV)
(g) Navier-Stokes Equations and Exact Solutions
(h) Similitude
(i) Internal Flow
(j) External Flow
(k) Laminar and Turbulent Boundary Layer or Compressible Flows

Course learning objectives
1. Hydrostatics Principles
   a) Learn to determine a pressure differential using manometry
   b) Learn to determine the pressure distributions, forces and moments on submerged surfaces.

2. Fluid Flow Conservation Laws
   a) Learn to apply the conservation of mass to a control volume.
   b) Learn to apply the conservation of linear momentum to a control volume.
   c) Learn to apply the conservation of energy to a control volume.
   d) Apply knowledge gained in parts a through c above to solve general fluid flow problems.
   e) Learn to apply the differential form of the mass conservation and the Navier-Stokes equations to solve simple incompressible laminar flow problems.

3. Similarity and Model Testing
   a) Learn the ideas behind fluid flow dynamic similarity.
   b) Learn how to determine non-dimensional groups.
   c) Learn to determine the parameters for model testing.

4. Internal Flow Characteristics
   a) Learn the distinction between laminar and turbulent pipe flow characteristics.
   b) Learn to calculate turbulent pipe flow problems including major and minor losses.

5. External Flow Characteristics
a) Learn the characteristics of laminar and turbulent boundary layers.
b) Learn the characteristics of external flows including flow separation, lift and drag coefficients.
c) Learn to solve for fluid forces on objects using lift and drag coefficient data.

6. Compressible Flow
   a) Isentropic speed of sound.
   b) Isentropic 1-D flows.
   c) Normal shock wave.

7. Laboratory Measurements
   a) Learn the use of flow visualization, pressure transducers, Pitot tubes, and hot-wire anemometry.
   b) Participate in computer data acquisition.
   c) Demonstrate basic fluid mechanics principles including hydrostatics, conservation of mass, momentum and energy, pressure variation along and normal to streamlines, laminar and turbulent flows.
   d) Participate in team building experiences through working in groups and a final group project.
   e) Communicate experimental results with written reports and a final project oral presentation.
   f) Organize the final project including the experimental methodology, setup, project timeline, data processing, and project result presentation (written and oral).

Relationship of course to ME program outcomes

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<thead>
<tr>
<th>Course outcomes</th>
<th>Relationship</th>
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<tr>
<td>3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.</td>
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<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering—3</td>
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<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data—3</td>
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<td>(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1</td>
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<td>(d) an ability to function on multidisciplinary teams—3</td>
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<td>(e) an ability to identify, formulate, and solve engineering problems—2</td>
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<td>(f) an understanding of professional and ethical responsibility—1</td>
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<td>(g) an ability to communicate effectively—3</td>
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<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1</td>
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<td>(i) a recognition of the need for and the ability to engage in life-long learning—1</td>
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<td>(j) a knowledge of contemporary issues—1</td>
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<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2</td>
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<td>(l) application of advanced mathematics—3</td>
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<td>(m) design, build, and test in mechanical systems area—1</td>
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<td>(n) design, build, and test in thermal/fluids area—1</td>
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<td>(o) capstone design experience—1</td>
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Contribution to professional component: 100% Engineering Science 0% Engineering Design

Person(s) who prepared this description: Ahmed Naguib and Indrek Wichman

Date of Preparation: -------