North Dakota State University
Department of Civil Engineering

CE 309 Fluid Mechanics (3 credits)

Date/Time/Place: Mon, Tue, Wed, Thu, Fri/9:00 – 11:15 AM/CIE 101
Instructor: Dr. Achintya N. Bezbaruah, 701-231-7461, a.bezbaruah@ndsu.edu
Office: CIE 201G
Office Hours: Mon thro’ Thur. 11:30 AM - 12:30 Noon, or by appointment (drop-ins are fine!)
Prerequisites: ME 222 (With a Grade of C or better; A student may not able to learn much in CE 309 if s/he registers for this course without fulfilling the prerequisites)


References: To be given by the instructor as needed.

General Description:
The course will introduce the concepts fluid mechanics and their engineering applications. The course will cover the physical properties of fluids (e.g., viscosity, density, and surface tension), statics (e.g., forces on submerged objects, manometers, and buoyancy), kinematics (e.g., geometry of fluid motion), fluid dynamics, fluid measurements, flow in pipes, losses in pipes, flow in open channels, and pumps.

Objectives: (ABET A, C, E, G, K)

1. To enable students to acquire develop the ability to apply knowledge of mathematics, science, and engineering. (ABET – A)
2. To enable students to acquire develop the ability to design a system, component, or process to meet desired needs. (ABET – C)
3. To enable students to acquire develop the ability to identify, formulate, and solve engineering problems. (ABET – E)
4. To enable students to acquire develop the ability to communicate effectively. (ABET – G)
5. To enable students to acquire develop the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. (ABET – K)

Outcomes (Outcomes of this course are tied to the Objectives set above):
By the end of this course, the students will be able to

1. Understand the basic properties of fluids and how to use these parameters to solve fluid mechanics problems (ABET A)
2. Able to determine the forces on submerged surfaces (ABET A)
3. Analyze closed systems (i.e., application of Bernoulli’s equation)(ABET A and E)
4. Analyze and design pipeline systems (ABET A, C, E, and K)
5. Analyze and design open channels (ABET A, C, E, and K)
6. Understand the concept of hydraulic jump and its engineering significance (ABET A)
7. Use the momentum equation to analyze engineering systems/components (ABET A)

Weightage for Outcomes:

<table>
<thead>
<tr>
<th>ABET Outcome</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (%)</td>
<td>50</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
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</table>

% Scale: 0% has no weight and 100% has the highest weight.
Grading Policy:

<table>
<thead>
<tr>
<th>Items</th>
<th>Relative Weightage</th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>40%</td>
</tr>
<tr>
<td>Tests, Quizzes, Final Exam</td>
<td>30%</td>
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<tr>
<td>Project</td>
<td>30%</td>
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<tr>
<td>Total</td>
<td>100%</td>
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**General Requirement:**
Topics to be discussed are indicated on the course outline. The information contained in the text book, reference books/articles and lectures may be used to develop homework or exam questions.

**Homework:**
Homework assignments and due dates will be announced in class. Solution sets will be accepted up to 3 days after the due date; however, late assignments (submitted after the due date) will receive a grade reduction (Reductions: 1 d late = 10%; 2 d late = 25%; 3 d late = 50%; More than 3 d late = 100%).

**Tests/Exam/Quiz:**
Tests and exams will be given as indicated on the course outline. Tests/exams may be open book, closed book, or a combination of open and closed book (to be announced beforehand). The format of an exam/test will be announced during a class prior to the exam/test. Quizzes may be given anytime with or without prior notice.

**Course Outcome Assessment:**
Upon completion of CE 309, the students should be able to achieve the abilities/outcomes listed earlier. These abilities will be assessed through homework problems, tests/exams/quizzes, and projects.

**Expectations of the Instructor:**
This is a required course and students are expected to do well in it. Inductive teaching techniques will be used as far as possible and applicable and as such your active participation is a must in this course. We will try to learn in a community environment. It is important that we make an extra effort to be in the class everyday. Students are expected to read beyond what is discussed in the class and browse the internet extensively. This course will try to break the inhibition one has towards topics related to fluid mechanics and will not (as it can’t) try to make experts out of the students.

**Students’ Expectations/Feedback:**
Students are requested to post their feedback/suggestions/criticism on the course during the semester by posting anonymous discussion on the Blackboard. A special forum (“Your Feedback is Important”) has been opened for this purpose in Discussion Board on the Blackboard.
North Dakota State University: Department of Civil Engineering

CE 309: Fluid Mechanics                  Summer 2007

COURSE OUTLINE/SCHEDULE

<table>
<thead>
<tr>
<th>Lecture #</th>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>May 14</td>
<td>Introduction, Units, Physical Characteristics of Fluids, Viscosity, Surface Tension, Vapor Pressure</td>
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<tr>
<td>2</td>
<td>May 15</td>
<td>Pressure and Pressure Measurement, Pressure on Plane Surfaces</td>
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<td>3</td>
<td>May 16</td>
<td>Pressure on Plane and Curved Surfaces</td>
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<td>4</td>
<td>May 17</td>
<td>Buoyancy and Liquid Subjected to Acceleration</td>
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<td>5</td>
<td>May 18</td>
<td>Test #1: Types of Flow, Streamlines, Flow Rate</td>
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<td>6</td>
<td>May 21</td>
<td>Velocity, Continuity Equation, Flow Net and Applications</td>
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<td>7</td>
<td>May 22</td>
<td>Velocity and Acceleration, Energies of Flowing Fluid, Bernoulli’s Equation</td>
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<td>8</td>
<td>May 23</td>
<td>Bernoulli’s Equation, Hydraulic Grade Line and Energy Line</td>
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<td>9</td>
<td>May 24</td>
<td>Hydraulic Grade Line and Energy Line and Their Applications, Momentum Principle</td>
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<td>10</td>
<td>May 25</td>
<td>Test #2; Application of Momentum Equation</td>
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<td>11</td>
<td>May 28</td>
<td>Memorial Day Holiday – No Class</td>
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<td>12</td>
<td>May 29</td>
<td>Application of Momentum Equation</td>
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<td>13</td>
<td>May 30</td>
<td>Laminar and Turbulent Flow in Pipes, Head Losses, Pipe Roughness and Friction Factors</td>
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<td>14</td>
<td>May 31</td>
<td>Single Pipe Flow with Losses, Branching Pipes, Pipes in Series, Pipes in Parallel</td>
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<tr>
<td>15</td>
<td>June 01</td>
<td>Test #3; Pipe Flow (continued)</td>
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<tr>
<td>16</td>
<td>June 04</td>
<td>Single Pipe Flow with Losses, Branching Pipes, Pipes in Series, Pipes in Parallel</td>
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<tr>
<td>17</td>
<td>June 05</td>
<td>Open Channel Flow, Most Efficient Cross-section</td>
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<td>18</td>
<td>June 06</td>
<td>Measurement of Fluid Properties</td>
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<td>19</td>
<td>June 07</td>
<td>Student Presentations</td>
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<tr>
<td>20</td>
<td>June 08</td>
<td>Final Exam</td>
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**Quizzes:** There will be surprise quizzes that will be done in class. Quizzes will be unannounced.
ABET

(www.abet.org)

ABET, Inc., is the recognized U.S. accreditor of college and university programs in applied science, computing, engineering, and technology. Accreditation ensures the quality of the postsecondary education students receive.

ABET was established in 1932 and is now a federation of 28 professional and technical societies representing the fields of applied science, computing, engineering, and technology.

Through the hard work and dedication of more than 1,500 volunteers, ABET currently accredits some 2,700 programs at over 550 colleges and universities nationwide.

ABET also provides leadership internationally through agreements such as the Washington Accord, and offers educational credentials evaluation services to those educated abroad through ECEI.

Accreditation Assures Quality

In the United States, accreditation is a non-governmental, peer review process that ensures educational quality. Educational institutions or programs volunteer to periodically undergo this review in order to determine if certain criteria are being met. It is important to understand, however, that accreditation is not a ranking system. It is simply assurance that a program or institution meets established quality standards.

There are two types of accreditation: institutional and specialized.

- **Institutional accreditation** evaluates overall institutional quality. One form of institutional accreditation is regional accreditation of colleges and universities.

- **Specialized accreditation** examines specific programs of study, rather than an institution as a whole. This type of accreditation is granted to specific programs at specific levels. Architecture, nursing, law, medicine, and engineering programs are often evaluated through specialized accreditation.

In the United States, ABET, Inc., is responsible for the specialized accreditation of educational programs in applied science, computing, engineering, and technology.

More general information about accreditation is available at www.chea.org.

What Is ABET Accreditation?

ABET accreditation is assurance that a college or university program meets the quality standards established by the profession for which it prepares its students. For example, an accredited engineering program must meet the quality standards set by the engineering profession. An accredited computer science program must meet the quality standards set by the computing profession.

ABET accredits postsecondary degree-granting programs housed within regionally accredited institutions. **ABET accredits programs only, not degrees, departments, colleges, or institutions.**

Who Sets the ABET Quality Standards?

The quality standards programs must meet to be ABET-accredited are set by the ABET professions themselves. This is made possible by the collaborative efforts of many different professional and technical societies. These societies and their members work together through ABET to develop the standards, and they provide the professionals who evaluate the programs to make sure they meet those standards.

Why Is ABET Accreditation Important?

- Accreditation helps students and their parents choose quality college programs.
- Accreditation enables employers to recruit graduates they know are well-prepared.
- Accreditation is used by registration, licensure, and certification boards to screen applicants.
- It is a structured mechanism to assess, evaluate, and improve the quality of one’s programs.
The ABET Accreditation Process

Accreditation is a voluntary process on the part of an institution. The first step is that an institution requests an evaluation of its program(s). (Only programs that have produced at least one graduate are eligible for accreditation.) Each program then conducts an internal evaluation and completes a self-study questionnaire. The self-study documents whether students, curriculum, faculty, administration, facilities, and institutional support meet the established criteria.

While the program conducts its self-examination, the appropriate ABET commission (Applied Science, Computing, Engineering, or Technology Commission) forms an evaluation team to visit the campus. A team chair and one or more program evaluators make up the evaluation team. Team members are volunteers from academe, government, and industry, as well as private practice.

During the on-campus visit, the evaluation team reviews course materials, student projects, and sample assignments and interviews students, faculty, and administrators. The team investigates whether the criteria are met and tackles any questions raised by the self-study.

Following its campus visit, the team provides the school with a written report of the evaluation. This allows the program to correct any misrepresentations or errors of fact, as well as address any shortcomings in a timely manner.

At a large annual meeting of all ABET commission members, the final evaluation report is presented by the evaluation team, along with its recommended accreditation action. Based on the findings of the report, the commission members vote on the action, and the school is notified of the decision. The information the school receives identifies strengths, concerns, weaknesses, deficiencies, and recommendations for improvements. Accreditation is granted for a maximum of six years. To renew accreditation, the institution must request another evaluation.

When you choose an accredited program, you are choosing wisely.

Accreditation assures that a program has met quality standards set by the profession.

To employers, graduate schools, and licensure, certification, and registration boards, graduation from an accredited program signifies adequate preparation for entry into the profession. In fact, many of these groups require graduation from an accredited program as a minimum qualification. Here are some examples:

- NICET Technologist Certification requires a bachelor's degree from an ABET-accredited engineering technology program.
- The United States Patent and Trademark Office requires applicants in computing to have graduated from an ABET-accredited computing program before they are eligible to sit for the Examination for Registration to Practice in Patent Cases.
- Many state boards of professional licensure in engineering and surveying require applicants to have graduated from an ABET-accredited program. In states where non-ABET graduates are permitted to be licensed, an additional four to eight years of work experience may be required.
- These certification bodies require additional experience and/or credentials evaluation for applicants who have graduated from non-ABET-accredited programs:
  - American Board of Industrial Hygiene
  - Board of Certified Safety Professionals
  - Construction Manager Certification Institute
  - Council on Certification of Health, Environmental, and Safety Technologists
  - Association for the Advancement of Cost Engineering

Be proud to choose an ABET-accredited program.

Whether you study applied science, computing, engineering, or technology, ABET accreditation is an important indicator of your program’s commitment to quality and may be a key to your professional future.