CENG 3404: Introduction to Fluid Mechanics Section 010 Monday, Wednesday and Friday 11:00 – 11:50 AM, Spring 2018

1: Instructor

- Aldo R. Pinon-Villarreal, PhD
- Phone: 325-486-5510
- Email: Aldo.Pinon-Villarreal@angelo.edu
- Office: West Annex-109
- Hours: Monday and Wednesday from 1:00 – 2:00 PM
- Tuesdays and Thursdays from 8:00 – 9:30 AM

2: Textbook and Required Materials

- Other materials as assigned.

3: Prerequisites

- ENGR 2302; Civil Engineering Majors only, or Departmental permission.

4: Course Description

This course introduces you to the principles of fluid mechanics and hydraulics. Topics covered include properties of fluids, hydrostatics, conservation of mass, momentum and energy applied to internal and external fluid flow, laminar and turbulent pipe flow, similitude and dimensional analysis. Laboratory collection and analysis of data from experiments are used to determine fluid and flow field properties with emphasis on conservation principles.

5: Student Learning Outcomes

When you complete this course you should be able to:

1. Describe, formulate and solve problems related to hydrostatics and internal fluid flow phenomena that considers conservation of mass, energy, and momentum.
2. Identify several important dimensionless parameters in fluid mechanics.
3. Apply the concepts of model and similitude to develop prediction equations.
4. Formulate and solve problems related to flow over immersed bodies (external flow).
5. The ability to design and conduct experiments, as well as to analyze and interpret data, pertaining to fluid mechanics.
6. Design a system to meet desired needs within realistic constraints such as physical, economic, health and safety, manufacturability, in a fluid mechanics context. Present and support design project recommendations in oral forms in a clear and effective way.
7. Function as a member or leader of a team in an effective and inclusive manner.
8. Acquire new knowledge by different learning strategies and make informed judgments about current engineering situations.

6: Course outcome mapping

The mapping of the course outcomes to the ABET Criterion 3 student outcomes is shown in Table 1.

Table 1: Course Outcome Mapping

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

7: Course structure and communication

There will be little or no lecture during class. You are expected to complete the assigned reading material before class. Instead of in class lectures, we will spend our class time working alone or in groups to accomplish hands on learning objectives. This will give us time in class to work on problems and projects. We will be using both Blackboard (Bb) and Piazza to communicate during this course. Piazza will be used for announcements and discussion of course materials. Please do not email your instructor with questions about class—instead post your questions on Piazza. One purpose of the discussions is to inform your instructor about any open questions from the reading or other material. It’s important that you provide feedback to your instructor.

7.1: Calculator policy

The use of a calculator is required and allowed on all exams and quizzes. Computers, tablets, smart phones, i-Pads and similar electronics are not allowed on tests/quizzes. Calculators with graphing capabilities will be allowed in the course. Recommended calculators with these capabilities include the HP48, HP49, HP50, TI86, and TI89. However, only calculators currently allowed in the Fundamentals of Engineering (FE) and Professional Engineering (PE) exams will be allowed in exams and quizzes. Please refer to the National Council of Examiners for Engineering and Surveying (NCEES) calculator policy for the list of acceptable calculators.

7.2: Professionalism

Professional engineering standard apply in this class. You are expected to demonstrate a behavior consistent with the conduct of an individual practicing in the engineering profession. You are expected to: (1) come prepared for class; (2) respect faculty and peers; (3) demonstrate responsibility and accountability for your own actions; (4) demonstrate sensitivity and appreciation for diverse cultures, backgrounds, and life experiences; (5) offer and accept constructive criticism in a productive manner; (6) demonstrate an attitude that fosters professional behavior among peers and faculty; (7) be punctual to class meetings; (8) maintain a good work ethic and integrity; and (9) recognize the classroom as a professional workplace.
8: Graded Material

8.1: Class Attendance, Participation, and Teamwork

Attendance and participation in class activities is essential for success in this class. You may miss up to three regular classes without penalty however you must attend each laboratory session in order to pass the course. Arriving late or leaving early will be counted as an absence. If you must miss a class or lab session due to an unforeseeable reason, you are expected to notify your instructor as early as possibly to make up for the missed materials or experiments, preferably before the absence.

You are expected to participate in class discussions on Piazza. This is the main forum for communicating with your instructor and fellow students. One purpose of the discussions is to inform your instructor about any open questions from the reading materials. It is important that you provide this feedback to your instructor. Additionally, a series of short pre-class questions regarding the reading assignments will be posted regularly in Piazza or Bb. It is important that you to answer these questions so that your instructor can identify topic materials that are confusing or may require more in deep clarification. You will be graded based on attendance, pre-class questions, and participation during classroom and in Piazza.

8.2: Quizzes

Unscheduled quizzes will be given throughout the entire semester during lectures and lab sessions. These are in-class short examinations of varying formats containing short answer, multiple choice, and calculation questions. The purpose of the quizzes is to encourage you to complete the reading and web-based content before class or lab. If you complete your reading assignments on time you should be able to know what to do during the class or lab sessions and get excellent scores on the quizzes, assignments and reports. You are allowed to use an NCEES-approved calculator and your NCEES FE Reference Handbook during quizzes.

8.3: Homework and Lifelong Learning Lessons

These will consist of textbook problems, additional problems, and short report type assignments (i.e., Lifelong learning Lessons or LLL). Due dates for Homework and LLLs will be listed in Bb.

8.4: Laboratory Reports

Weekly laboratory sessions will be undertaken to conduct experiments, visualize concepts covered in class, or to work in your design project. The instructor will post the handouts for every lab in Bb at least a week in advance of the session; make sure to read before coming to the session (a short quiz will be given before the experiment). Nearly every session requires submission of an individual properly-written report. Each lab report will be due at the beginning of the lab session, one week after the lab was performed.

8.5: Final Design Project

This is a team project. The project will focus on the design and construction of a functional system that includes one or more hydraulic component. The project will be divided into a number of separate submittals throughout the semester. Your team will present your final proposed solution via oral presentation and delivering two summary PowerPoint slides. Due dates will be listed in Blackboard.

8.6: Exams

There will be a total of three partial and one final comprehensive exam required to pass the course. All the three exams are closed-notes. You will be allowed to use the NCEES FE Reference Handbook during exams and to bring a NCEES approved calculator.
8.7: Late Assignments
No late assignments or missed assignments will be accepted unless a prior arrangement has been made with the instructor. All arrangements must be accompanied by a memorandum containing (i) the reason for the late submission, (ii) specific preventive action(s) to ensure the situation, if preventable, does not repeat in the future, and (iii) a proposed new timeline for the submission. Acceptance of the terms and grade deduction for late assignment is at the discretion of your instructor.

8.8: Grades: Weighting and Letter Grades
The weighting system shown in Table 2 will be used in determining final grade for the course

<table>
<thead>
<tr>
<th>Item</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance, Participation, and Pre-class Questions</td>
<td>6%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>8%</td>
</tr>
<tr>
<td>Homework and Lifelong Learning Lessons</td>
<td>12%</td>
</tr>
<tr>
<td>Laboratories (90% Reports + 10% Lab Quizzes)</td>
<td>14%</td>
</tr>
<tr>
<td>Design Project</td>
<td>10%</td>
</tr>
<tr>
<td>Partial Exams (3 at 10% each)</td>
<td>30%</td>
</tr>
<tr>
<td>Final Exam (Comprehensive)</td>
<td>20%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

The instructor will determine letter grades for the course using his professional judgment, and the following standards as described in the University Catalog:

A = excellent work (> 89%), B = good work (80-89%), C = average work (70-79%), D = poor work (60-69%), F = failing work (< 60%).

9: Classroom and University Policies and Student Support

9.1: General Policies
All students are required to follow the policies and procedures presented in the Angelo State University Student Handbook and Angelo State University Catalog.

9.2: Student Disability Services
ASU is committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs or activities of the university, or be subjected to discrimination by the university, as provided by the Americans with Disabilities Act of 1990 (ADA), the Americans with Disabilities Act Amendments of 2008 (ADAAA), and subsequent legislation.

The Office of Student Affairs is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability, and it is the student’s responsibility to initiate such a request by contacting Ms. Dallas Swafford, Director of Student Disability Services, at 325-942-2047 or Dallas.Swafford@angelo.edu, or visit the Student Disabilities Services website.

9.3: Title IX Statement
Angelo State University is committed to the safety and security of all students. If you or someone you know experience sexual harassment, sexual assault, domestic or dating violence, stalking, or discrimination, you may contact ASU’s Title IX Coordinator: Ms. Michelle Boone, Director of Title IX Compliance, at 325-486-6357, or Michelle.Boone@Angelo.Edu.
9.4: **Observance of Religious Holy Day**

A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. See ASU Operating Policy 10.19 Student Absence for [Observance of Religious Holy Day](#) for more information.

9.5: **Incomplete Grade Policy**

It is policy that incomplete grades be reserved for student illness or personal misfortune. Please contact faculty if you have serious illness or a personal misfortune that would keep you from completing course work. Documentation may be required. See ASU Operating Policy 10.11 [Grading Procedures](#) for more information.

9.6: **Student Conduct Policies**

**Academic Integrity**

Students are expected to maintain complete honesty and integrity in all work. Any student found guilty of any form of dishonesty in academic work is subject of disciplinary action and possible expulsion from ASU.

The College of Science and Engineering adheres to the Statement of [Academic Integrity](#).

**Plagiarism**

Plagiarism is a serious topic covered in ASU’s [Academic Integrity policy](#) in the Student Handbook. Plagiarism is the action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own. Plagiarism is literary theft.

In your discussions and/or your papers, it is unacceptable to copy word-for-word without quotation marks and the source of the quotation. It is expected that you will summarize or paraphrase ideas giving appropriate credit to the source both in the body of your paper and the reference list.

Papers are subject to be evaluated for originality via Turnitin. Resources to help you understand this policy better are available at the [ASU Writing Center](#).

**Copyright Policy**

Students officially enrolled in this course should make only one printed copy of the given articles and/or chapters. You are expressly prohibited from distributing or reproducing any portion of course readings in printed or electronic form without written permission from the copyright holders or publishers.

10: **Instructor Prerogative**

Your instructor may change policies, procedures, of this course when he deems it necessary. You will be notified of any such changes.

11: **Format of Quizzes, Homework Assignments, and Laboratory Reports**

Hand written problem sets must be completed on engineering paper using the format shown in Figure 1. All hand-written pages must be numbered and contain the header information shown in Figure 1. Work completed using a computer may be submitted on regular 8 x 11 in. paper. Drawings, plans and maps can be printed in 11 x 17 in. paper folded in half and attached to the report(s). Every report will require a cover page containing the student name, names of team members, as well as course name, instructor name, date when experiment/analysis was undertaken, and report submission date. See handout Writing of Laboratory Reports in the Supplementary Materials Module in Bb for more information.
Given: Perez & Rabjohns, prob 6.13

A ship on a lake is sighted from 2 stations located 521.67' apart, along an E-W baseline. The azimuth measured from the westernmost station is 300°17'23''. The azimuth measured from the easternmost station is 321°47'08''.

Find: The distance from the baseline to the ship.

Solution:

\[ \alpha = 90° - 30°17'23'' = 59°42'37'' \]
\[ \beta = 321°47'08'' - 270° = 51°47'08'' \]
\[ \gamma = 180° - \alpha - \beta = 180° - 59°42'37'' - 51°47'08'' = 69°30'15'' \]

Using law of sines

\[ \frac{AP}{\sin \gamma} = \frac{521.67'}{\sin \beta} \]

Figure 1: Required format for handwritten homework

12: Course Outline

The course outline is presented in Table 3. Detailed homework assignments along with updates to this schedule will be provided via Bb.
Table 3: Course Lesson Outline (laboratories listed in the line below lecture topics). The last section of each listed chapter contains a summary which is recommended to review.

<table>
<thead>
<tr>
<th>Wk</th>
<th>Dates</th>
<th>Lecture Topics</th>
<th>Textbook Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 17, 19</td>
<td>Introduction, dimensions &amp; units, fluid properties</td>
<td>§ 1.1-1.4</td>
</tr>
<tr>
<td>2</td>
<td>Jan 22, 24, 26</td>
<td>Viscosity, compressibility, surface tension, ideal gas law</td>
<td>§ 1.5-1.9 (skip 1.8)</td>
</tr>
<tr>
<td>3</td>
<td>Jan 29, 31, Feb 2</td>
<td>Pressure variation, compressible &amp; uncompressible fluids, Basic Manometry</td>
<td>§ 2.1-2.5, 2.7</td>
</tr>
<tr>
<td>4</td>
<td>Feb 5, 7, 9</td>
<td>Manometry, hydrostatic forces on plane surface; Exam 1</td>
<td>§ 2.6, 2.8</td>
</tr>
<tr>
<td>5</td>
<td>Feb 12, 14, 16</td>
<td>Hydrostatic forces on curved surfaces, Hydrostatic Forces – The center of pressure</td>
<td>§ 2.9-2.10</td>
</tr>
<tr>
<td>6</td>
<td>Feb 19, 21, 23</td>
<td>Buoyancy, flotation, stability, The free jet – Curvilinear flow</td>
<td>§ 2.11</td>
</tr>
<tr>
<td>7</td>
<td>Feb 26, 28, Mar 2</td>
<td>Streamlines, Bernoulli equation, Continuity equation, Bernoulli demonstration</td>
<td>§ 3.1-3.7</td>
</tr>
<tr>
<td>8</td>
<td>Mar 5, 7, 9</td>
<td>Reynolds transport theorem, conservation of mass; Exam 2, Flow measurement using pitot tube</td>
<td>§ 4.4-4.4.1</td>
</tr>
<tr>
<td>9</td>
<td>Mar 12, 14, 16</td>
<td>Spring Break, No Lab</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Mar 19, 21, 23</td>
<td>Linear momentum eqn., forces by fluids in motion, energy equation, Impact of fluid jet</td>
<td>§ 5.2 (skip 5.2.3), § 5.3 (skip 5.3.4 &amp; 5.3.5)</td>
</tr>
<tr>
<td>11</td>
<td>Mar 26, 28, 30</td>
<td>Dimensional analysis, Buckingham Theorem, Working on fountain project: Pump characteristic curve</td>
<td>§ 7.1-7.5</td>
</tr>
<tr>
<td>12</td>
<td>Apr 2, 4, 6</td>
<td>Dimensionless numbers, modeling and similitude</td>
<td>§ 7.6-7.9</td>
</tr>
<tr>
<td>13</td>
<td>Apr 9, 11, 13</td>
<td>Characteristics of pipe flow, laminar and turbulent flow, Major headlosses</td>
<td>§ 8.1-8.3 (skip 8.22, 8.23, 8.24,8.32, 8.34, 8.35)</td>
</tr>
<tr>
<td>14</td>
<td>Apr 16, 18, 20</td>
<td>Major and Minor losses, pipe flowrate measurement, Open channel flow measurement or field trip</td>
<td>§ 8.4 - 8.6 (skip 8.5.2)</td>
</tr>
<tr>
<td>15</td>
<td>Apr 23, 25, 27</td>
<td>Flow over immersed bodies; Exam 3, Working on fountain project: System calculations</td>
<td>§ 9.1</td>
</tr>
<tr>
<td>16</td>
<td>Apr 30, May 2, 4</td>
<td>Drag and lift forces, final exam review, Final project presentations</td>
<td>§ 9.3-9.4 (skip 9.4.2)</td>
</tr>
<tr>
<td>17</td>
<td>May 9</td>
<td>Final Exam Wednesday May 9 from 10:30 AM to 12:30 PM</td>
<td></td>
</tr>
</tbody>
</table>

1 http://ncees.org/exams/calculator-policy/
2 http://www.angelo.edu/student-handbook/
3 http://www.angelo.edu/catalogs/
4 http://www.angelo.edu/services/disability-services/
5 http://www.angelo.edu/content/files/14206-op-1019-student-absence-for-observance-of
6 http://www.angelo.edu/content/files/14197-op-1011-grading-procedures
7 http://www.angelo.edu/student-handbook/community-policies/academic-integrity.php
8 http://www.angelo.edu/dept/writing_center学术_honesty.php