1. **Course Number and Name**
   a. **ENGR 3404**: Introduction to Fluid Mechanics, Spring 2021
   b. Section 010, MWF 9:00 – 9:50 am in VIN 241

2. **Credits and Contact Hours**
   a. **Credits**: 4
   b. **Contact Hours**: 3 hours/week (Classroom) 3 hours/week (Lab)

3. **Instructor Information**
   a. **Course Coordinator**: Aldo R. Pinon-Villarreal
   b. **Instructor**: Aldo R. Pinon-Villarreal, 325-486-5510, apinonvillarreal@angelo.edu.
   Office: VIN 272. For office hours see faculty homepage.
   c. Office hours: T 10:00–11:00 am (VIN 272 and Virtual Hub), W-Th: 2:00–4:00 pm (Engineering Hub VIN 254 and virtual Hub).

4. **Required Course Materials**
   a. **Required Textbook**:
   b. **Other Supplemental Materials**: Posted on Blackboard® Learning Management System

5. **Technology Requirements**
   - Top Hat Pro ([www.tophat.com](http://www.tophat.com)) will be used for class participation. Cost of Top Hat Pro is $22 per semester. If you already have Top Hat account, go to [https://app.tophat.com/e/783601](https://app.tophat.com/e/783601) to be taken directly to our course. If you are new to Top Hat, go to [https://app.tophat.com/register/student](https://app.tophat.com/register/student) and search for our course with the following join code: 783601. For more instructions refer to the invitation sent to your school email address or consult Top Hat’s Getting Started Guide ([https://bit.ly/31TGMLw](https://bit.ly/31TGMLw)). For questions or support send an email to support@tophat.com, use the in-app support button, or call 1-888-663-5491.
   - WileyPlus Online Assignment Content. Instructions for logging will be provided shortly.

6. **Specific Course Information**
   a. **Catalog Description**: Introduction of properties of fluids, conservation of mass, energy and momentum with applications to internal and external flows. Laboratory collection and analysis of data from experiments to determine fluid and flow field properties with emphasis on conservation principles.
   b. **Prerequisites and Corequisites**: Prerequisites: ENGR 2302: Engineering Mechanics – Dynamics.
   c. **Required or Elective**: Required for the BSCE and MSCE majors.
7. **Specific Goals for the Course**

a. **Course Learning Outcomes:**
   1. Evaluate basic fluid properties
   2. Solve fluid statics problems
   3. Apply the basic laws of fluid mechanics
   4. Perform control volume analysis for mass and momentum transfer
   5. Apply dimensional analysis and similitude to generalize empirical results
   6. Calculate head losses for internal, viscous, incompressible flows
   7. Evaluate viscous drag force using differential boundary layer analysis
   8. Calculate drag and lift forces for external, viscous, incompressible flows
   9. Conduct appropriate experimentation, analyze and interpret experimental data in topics of fluid properties, hydrostatics, flow measurement, and viscous flow in pipes.
   10. Design a simple hydraulic system to meet desired needs with physical, economic and manufacturability constraints
   11. Present and support project recommendations in oral and written forms.

b. **Course Learning Outcome Mapping to ABET Criterion 3 Student Outcomes:**

Table 1: Course Learning Outcomes mapped to ABET Student Outcomes

<table>
<thead>
<tr>
<th>ABET Student Outcomes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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</thead>
<tbody>
<tr>
<td>1. Solve Problems</td>
<td>X</td>
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<td>2. Design</td>
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<td>3. Communication</td>
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<td>X</td>
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<td>4. Ethics &amp; Professionalism</td>
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<td>X</td>
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<td>5. Teamwork</td>
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<td></td>
<td>X</td>
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<td>X</td>
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<tr>
<td>6. Experimentation</td>
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<td>X</td>
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<tr>
<td>7. Acquire New Knowledge</td>
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</tbody>
</table>

8. **Topics Covered**

   1. Basic concepts of fluids
   2. Fluid properties
   3. Hydrostatics
   4. Fluid Kinematics
   5. Buoyancy
   6. Reynolds transport theorem
   7. Control volume analysis for conservation of mass, momentum and Energy
   8. Differential analysis for a fluid system
   9. Bernoulli’s equation
   10. Dimensional analysis
   11. Internal Viscous flow
   12. External flows
   13. Solutions of Navier Stokes Equations – Couette flow, Channel flow and Creeping flow
   14. Introduction to Boundary Layer Theory
9. **Course Delivery and Communications**

9.1 **Delivery Method(s)**

This is a face-to-face course with learning resources and supplemental materials posted in Blackboard. All lectures will be recorded. Some parts of the course such as laboratory or project assignments may be provided via video webcasts posted in blackboard asynchronously.

9.2 **Communications**

The instructor will respond to email and/or telephone messages within 24 hours during working hours Monday through Friday. Weekend messages may not be returned until Monday.

**Written communication via email:** All private communication will be done exclusively through your ASU email address. Check frequently for announcements and policy changes in your email and Bb announcement board. In your emails to faculty, include the course name and section number in your subject line.

**Office Hours:** The instructor will be holding face-to-face and virtual office hours simultaneously. Virtual Office hours will be undertaken via Blackboard Collaborate. Instructions to join the virtual office hours:

1. In your Blackboard go to the Home tab then go to My organizations module
2. Select Engineering Community Organization, which looks like a regular course Blackboard page.
3. On the organization menu, select Virtual Engineering Hub which takes you to a Collaborate Ultra virtual meeting room.
4. In there, find the correct Office Hours Session series in the scheduled Collaborate sessions (e.g., Prof. Pinon Tuesdays Office Hours)

**Online Etiquette.** Follow etiquette guidelines and proper grammar when writing posts or communications online.

9.3 **Calculator policy**

The use of a calculator is required and allowed on all tests and Top Hat problems. Calculators with graphing capabilities will be allowed in the course but not during tests. 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 Celebration of Knowledge tests and In-class problems. Please refer to the NCEES calculator policy for the list of acceptable calculators.

10. **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;
9. recognize the classroom as a professional workplace.
11. Graded Material

11.1 Class Attendance, Participation, Timeliness and Teamwork

The number one complaint of engineering clients is the timeliness of deliverables (reports, drawings, specifications, etc.). As a professional engineer you will be expected to arrive at scheduled meetings on time and prepared. Late proposals are not generally accepted. Late specifications or drawings may cost the engineer a monetary penalty. Professional engineering standards apply in this course.

You are expected to meet every class meeting on time and prepared. Attendance will be taken. Should you find it necessary to miss a class for any reason, you are expected to notify your instructor as early as the absence is known—preferably before the absence. It’s important that you communicate clearly your instructors.

Your online assignments will be due at the time specified on Bb. Any assignments submitted in hard copy are due at the beginning of class on the due date. Your instructor may assess penalties for late work.

11.2 Reading Assignments and Top Hat Problems

Students are expected to complete the reading assignments from the assigned textbook or materials posted in Bb according to the syllabus schedule. In-class and/or outside-class top hat questions will be assigned by the instructor to test your proficiency on the material covered. Late submissions may be penalized or not accepted. At the end of the semester, the lowest top hat problem set will be dropped. This will also count towards any lost points or missed problems.

11.3 WileyPlus Assignments

Homework assignment will be posted weekly on WileyPLUS via Blackboard. The assignments include both conceptual questions and numerical problems about the materials covered in the last or next lecture. You are required to do your homework online using WileyPLUS. The system provides five opportunities to enter the correct answer to each question before it is graded.

Students may collaborate to complete the homework; however, each student must individually complete his/her own assignment for grading. Direct copying of other’s work is not allowed and may be subject to disciplinary actions. At the end of the semester, the lowest assignment grade will be dropped. This will also count towards any lost points or missed assignment.

11.4 Celebrations of Knowledge

There will be a total of three partial and one final Celebrations of knowledge during the semester to assess what you have learned in each module. These will be closed textbook and closed notes, and only a provided equation sheet and the NCEES FE handbook can be used as a reference document. Online and Make-up exams will only be given for extenuating circumstances, unless prior arrangements with the instructor are agreed upon. Proof, such as a doctor’s note or other official document, may be required for unexcused absences during an exam.
11.5 Grades: Weighting and Letter Grades

The weighting system shown in Error! Reference source not found. will be used in determining final grade for the course.

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>12</td>
</tr>
<tr>
<td>Top Hat Problems</td>
<td>7</td>
</tr>
<tr>
<td>Laboratories</td>
<td>15</td>
</tr>
<tr>
<td>Design Project</td>
<td>10</td>
</tr>
<tr>
<td>Celebrations of Knowledge: 3 x 12 each</td>
<td>36</td>
</tr>
<tr>
<td>Final Celebration of Knowledge</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
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</tbody>
</table>

The instructor reserves the right to adjust the weights given to the components listed. The instructor will determine letter grades for the course using his professional judgment, and the following standards as described in the University Catalog:

- A (>90%) = excellent work
- B (80 – 89%) = good work
- C (70 – 79%) = average work
- D (60 – 69%) = poor work
- F (>60%) = failing work

12. Classroom and University Policies and Student Support

12.1 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.

12.2 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.

Student Disability Services is located in the Office of Student Affairs, and is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability. It is the student’s responsibility to initiate such a request by contacting an employee of the Office of Student Affairs, in the Houston Harte University Center, Room 112, or contacting the department via email at ADA@angelo.edu. For more information about the application process and requirements, visit the Student Disability Services website. The employee charged with the responsibility of reviewing and authorizing accommodation requests is:
Dallas Swafford  
Director of Student Disability Services  
Office of Student Affairs  
325-942-2047  
dallas.swafford@angelo.edu  
Houston Harte University Center, Room 112

12.3 Title IX at Angelo State University

The University prohibits discrimination based on sex, which includes pregnancy, sexual orientation, gender identity, and other types of Sexual Misconduct. Sexual Misconduct is a broad term encompassing all forms of gender-based harassment or discrimination including: sexual assault, sex-based discrimination, sexual exploitation, sexual harassment, public indecency, interpersonal violence (domestic violence and/or dating violence), and stalking. As a faculty member, I am a Responsible Employee meaning that I am obligated by law and ASU policy to report any allegations I am notified of to the Office of Title IX Compliance.

Students are encouraged to report any incidents of sexual misconduct directly to ASU’s Office of Title IX Compliance and the Director of Title IX Compliance/Title IX Coordinator at:

Michelle Boone, J.D.  
Director of Title IX Compliance/Title IX Coordinator  
Mayer Administration Building, Room 210  
325-486-6357, michelle.boone@angelo.edu

You may also file a report online 24/7 at www.angelo.edu/incident-form6

If you are wishing to speak to someone about an incident in confidence you may contact the University Health Clinic and Counseling Center at 325-942-2173 or the ASU Crisis Helpline at 325-486-6345.

For more information about resources related to sexual misconduct, Title IX, or Angelo State’s policy please visit: www.angelo.edu/title-ix7.

12.4 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 Day8 for more information.

12.5 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 Procedures9 for more information.

12.6 Student Conduct Policies

12.6.1 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.
12.6.2  Plagiarism

Plagiarism is a serious topic covered in ASU’s Academic Integrity policy\(^{10}\) 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 or SafeAssign. Resources to help you understand this policy better are available at the ASU Writing Center\(^{11}\).

12.6.3  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.
13. Course Outline

The course outline is presented in next page. Detailed homework assignments along with updates to this schedule will be provided via Blackboard. The course outline is presented in Table 3. Detailed reading and homework assignments along with updates to this schedule will be provided via Bb. The following schedule may be modified as the semester progresses.

Table 3: Course Lecture Schedules

<table>
<thead>
<tr>
<th>Day</th>
<th>Chapter Topic</th>
<th>Laboratory (M and W sections)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 25</td>
<td>INTRODUCTION</td>
<td>Introduction, lab safety; use of statistics and spreadsheets</td>
</tr>
<tr>
<td></td>
<td>1.1 Some Characteristics of Fluids</td>
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<td></td>
<td>1.2 Dimensional Homogeneity and Units</td>
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<tr>
<td>27</td>
<td>1.4 Measures of Fluid Mass and Weight</td>
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<tr>
<td>29</td>
<td>1.5 Ideal Gas Law</td>
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<tr>
<td>Feb 1</td>
<td>1.6 Viscosity</td>
<td>Lab 1. Measurement of fluid properties &amp; viscosity</td>
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<tr>
<td>3</td>
<td>1.7 Compressibility of Fluids</td>
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<td></td>
<td>1.8 Vapor Pressure (Cavitation)</td>
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<tr>
<td>5</td>
<td>1.9 Surface Tension</td>
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<tr>
<td>8</td>
<td>2 FLUID STATICS</td>
<td>Lab 2. Basic Manometry</td>
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<tr>
<td></td>
<td>2.1 Pressure at a Point</td>
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<td></td>
<td>2.2 Basic Equation for Pressure Field</td>
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<tr>
<td>10</td>
<td>2.3 Pressure Variation in a Fluid at Rest</td>
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<tr>
<td>12</td>
<td>2.5 Measurement of Pressure (read on your own)</td>
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<tr>
<td>15</td>
<td>2.8 Hydrostatic Force on a Plane Surface</td>
<td>Lab 3. Hydrostatic Forces – The Center of Pressure</td>
</tr>
<tr>
<td>17</td>
<td>2.10 Hydrostatic Force on a Curved Surface</td>
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<tr>
<td>19</td>
<td>2.10 (Continuation)</td>
<td></td>
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<tr>
<td>24</td>
<td>2.12 Pressure Variation in a Fluid with Rigid-Body Motion</td>
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<tr>
<td>26</td>
<td>3 ELEMENTARY FLUID DYNAMICS—THE BERNOULLI’S EQN (BE)</td>
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<tr>
<td></td>
<td>3.1 Newton’s Second Law</td>
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<td></td>
<td>3.2 F = ma along a Streamline</td>
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<tr>
<td>Mar 1</td>
<td><strong>Celebr Knowldg 1 (Chapters 1.1-2.12)</strong></td>
<td>Fountain Pump Head Curve Measurement</td>
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<tr>
<td>3</td>
<td>3.3 F = ma Normal to a Streamline</td>
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<tr>
<td>5</td>
<td>3.5 Static, stagnation, dynamic and total pressure</td>
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<tr>
<td>8</td>
<td>3.6 Examples of Use of the Bernoulli Equation</td>
<td>Lab 5. Flow measurement using pitot tube.</td>
</tr>
<tr>
<td>10</td>
<td>4 FLUID KINEMATICS</td>
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<tr>
<td>12</td>
<td>4.2 The Acceleration Field</td>
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</tbody>
</table>
| 15 | 4.3 Control Volume and System Representations  
    4.4 The Reynolds Transport Theorem | Lab 6. The free jet-Curvilinear flow |
| 17 | 5 FINITE CONTROL VOLUME ANALYSIS  
    5.1 Conservation of Mass—The Continuity Equation |  |
| 19 | 5.2 Newton’s Second Law—The Linear Momentum Eqn |  |
| 22 | 5.2 (Continuation) | Flow in Pipes Theory and Fountain Calculations |
| 24 | 5.3 First Law of Thermodynamics—The Energy Equation |  |
| 26 | 5.3 (Continuation) |  |
| 29 | Celeb Knowldg 2 (chapters 3.1-5.3) | Lab 7. Impact of Fluid Jet. |
| 31 | 7 DIMENSIONAL ANALYSIS, SIMILITUDE AND MODELING  
    7.1 The Need for Dimensional Analysis  
    7.2 Buckingham Pi Theorem  
    7.3 Determination of Pi Terms |  |
| April 2 | Spring Holiday — No Class |  |
| 5 | 7.4 Some Additional Comments about Dimensional Analysis  
| 7 | 7.8. Modeling and Similitude |  |
| 9 | 8 VISCOUS FLOW IN PIPES  
    8.1 General Characteristics of Pipe Flow  
    8.2 Fully developed Laminar flow |  |
| 12 | 8.4 Dimensional Analysis of Pipe Flow  
    Major and minor energy losses  
    Pipe flowrate measurement | Lab 9. Minor headlosses |
| 14 | 8.4.3 Flow in non-circular conduits |  |
| 16 | 8.5 Pipe Flow Examples |  |
| 19 | 6 DIFFERENTIAL ANALYSIS OF FLUID FLOW  
    6.1 Fluid Element Kinematics  
    6.2 Conservation of Mass | Work on Project (No lab experiment) |
| 21 | 6.3 The Linear Momentum Equation  
    6.4 Inviscid Flow  
    6.8 Viscous Flow |  |
| 23 | 6.8 Continuation |  |
| 26 | 6.9 Some Simple Solutions for Laminar, Viscous, Incompressible Flows  
    6.10 Other Aspects of Differential Analysis | Display Fountain and Submit Project video |
| 28 | Celeb Knowldg 3 (chapters 7.1-6.10) |  |
| 30 | 9.1FLOW OVER IMMERSED BODIES  
    General External Flow Characteristics  
    9.2 Boundary Layer Characteristics |  |
| May 3 | 9.3-9.4 Drag and Lift | Final Celeb Review |
| 5 | 9.3-9.4 Drag and Lift Examples |  |
| 7 | Final Exam Review |  |
| May 12 | Final Celeb. Knowledge, 8:00 to 10:00 am. |  |

End Notes

1 [https://ncees.org/engineering/fe/](https://ncees.org/engineering/fe/)  