1. Course Number and Name

a. **ENGR 3404**: Introduction to Fluid Mechanics, Spring 2022
b. Section 010, MWF 10:00 – 10:50 am in VIN 287

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[1].

4. Required Course Materials

a. **Required Textbook**:

- Andrew L. Gerhart, John I. Hochstein and Philip M. Gerhart (eds). (2021). *Fundamentals of Fluid Mechanics*, 9th Edition. ISBN: 9781119499220. John Wiley & Sons, Inc. (WileyPLUS subscription required).
- National Council of Examiners for Engineering and Surveying (NCEES). (2020). *Fundamentals of Engineering (FE) Supplied–Reference Handbook*, version 10.01, 280 Seneca Creek Road, Clemson, SC 29631. Available for download through the NCEES Website[2] after creating a free student account.

b. **Other Supplemental Materials**: Posted on Blackboard® Learning Management System

5. Technology Requirements

This course requires internet access and the ability to use the following online tools: Blackboard, Wiley Plus, Gradescope, Google meet, Google Drive, Adobe Acrobat (or another pdf maker), YouTube.

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 loses 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

ABET Student Outcomes	1	2	3	4	5	6	7	8	9	10	11
1. Solve Problems		X	X	X	X	X	X	X			
2. Design										X	
3. Communication									X		X
4. Ethics & Professionalism										X	X
5. Teamwork									X	X	X
6. Experimentation									X	X	
7. Acquire New Knowledge											

8. Topics Covered

1. Fluid properties
2. Hydrostatics
3. Fluid Kinematics
4. Buoyancy
5. Reynolds transport theorem
6. Control volume analysis for conservation of mass, momentum and Energy
7. Differential analysis for a fluid system
8. Bernoulli's equation
9. Dimensional analysis
10. Internal Viscous flow
11. External flows
12. Solutions of Navier Stokes Equations applied to simple flow situations
13. 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[3]. Accommodations will be made for students who are in quarantine or isolation and are unable to attend.

9.2 Communications

You may communicate with me via Blackboard discussion board, email, phone, or via GroupMe text.

I will respond to email 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 emails to faculty, include the course name and section number in your subject line.

Office hours or advising may be arranged with the assistance of Collaborate, Zoom, or another web meeting platform.

9.3 Calculator policy

The use of a calculator is required and allowed on all tests and online quizzes. 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[4] 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; and (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 with your instructors.

Your online assignments will be due at the time specified on Gradescope. 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 *WileyPlus Assignments*

Homework assignment will be posted weekly on WileyPLUS via Blackboard. Instructions for logging will be sent to you soon. The assignments include both conceptual questions and numerical problems about the materials covered in the last or next lecture. The WileyPLUS system provides three opportunities to enter the correct answer for the conceptual questions and five opportunities for the numerical questions before each question 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.

11.3 *Pre-lab Quizzes*

Before each lab you are required to read the corresponding lab manual, watch a video and complete a pre-lab quiz. These quizzes are designed to ensure you have read the pre-lab material and are prepared for the lab.

11.4 *Lab Reports*

You must pass the lab portion of the class as a whole in order to pass the course. You will have ten lab reports due throughout the course of the semester. The very first lab report will be prepared individually, and the rest will be team submitted lab reports.

11.5 *Term Design Project*

You will be assigned a semester long design project that will be undertaken in teams of three people. The project consists of designing and creating a simple hydraulic system to meet desired needs with physical, economic and manufacturability constraints. You will submit severalm short submitals and a final report documenting your design process and results showing that you project meets all the constraints.

11.6 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.

If your tentative final cumulative grade day on the last day of classes above 79.99 you are exempt to take the final exam and your official course grade will be based on 80% of the course available points (excluding 20% for the final celebration). If your tentative cumulative grade is at or below 79.99 you are required to take the test. Failure to take the final if your tentative final grade is at or below 79.99 will result in getting a zero for that test and you may fail the course.

11.7 Grades: Weighting and Letter Grades

The weighting system shown in Table 2 will be used in determining final grade for the course

Table 2: Grade Weighting

Course Component	Percent
WileyPlus Homework	12
Attendance and Participation	5
Laboratories	15
Design Project	12
Celebrations of Knowledge: 3 x 12 each	36
Final Celebration of Knowledge	20
Total	100

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, (60 – 69%) = poor work, F (>60%) = failing work

11.8 *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[5] for more information.

12. Classroom and University Policies and Student Support

All students are required to follow the policies and procedures presented in the Angelo State University Student Handbook[6] and Angelo State University Catalog[7].

12.1 *Accommodations for Students with Disabilities*

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.[8] The employee charged with the responsibility of reviewing and authorizing accommodation requests is:

Dr. Dallas Swafford
Director of Student Disability Services
Office of Student Affairs
325-942-2047
dallas.swafford@angelo.edu
Houston Harte University Center, Room 112

12.2 *Title IX at Angelo State University*

Angelo State University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from sex discrimination of any kind. In accordance with Title VII, Title IX, the Violence Against Women Act (VAWA), the Campus Sexual Violence Elimination Act (SaVE), and other federal and state laws, the University prohibits discrimination based on sex, which includes pregnancy, and other types of Sexual Misconduct. Sexual Misconduct is a broad term encompassing all forms of gender-based harassment or discrimination and unwelcome behavior of a sexual nature. The term includes sexual harassment, nonconsensual sexual contact, nonconsensual sexual intercourse, sexual assault, sexual exploitation, stalking, public indecency, interpersonal violence (domestic violence or dating violence), sexual violence, and any other misconduct based on sex.

You are encouraged to report any incidents involving sexual misconduct to the Office of Title IX Compliance and the Director of Title IX Compliance/Title IX Coordinator, Michelle Miller, J.D. You may submit reports in the following manner:

Online: Incident Reporting Form[9]
Face to Face: Mayer Administration Building, Room 210
Phone: 325-942-2022
Email: michelle.miller@angelo.edu

Note, as a faculty member at Angelo State, I am a mandatory reporter and must report incidents involving sexual misconduct to the Title IX Coordinator. Should you wish to speak to someone in confidence about an issue, you may contact the University Counseling Center (325-942-2371), the 24-Hour Crisis Helpline (325-486-6345), or the University Health Clinic (325-942-2171).

For more information about resources related to sexual misconduct, Title IX, or Angelo State's policy please visit the Title IX website.[10]

12.3 *Student Absence for Observance of Religious Holy Days*

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[11] for more information.

12.4 *Information About COVID-19*

Please refer to ASU's COVID-19 (Coronavirus) Updates[12] web page for current information about campus guidelines and safety standards as they relate to the COVID-19 pandemic.

12.5 *Student Conduct Policies*

12.5.1 *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.

12.5.2 *Plagiarism*

Plagiarism is a serious topic covered in ASU's Academic Integrity policy[13] 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[14].

12.5.3 *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 Table3. 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.

Table3: Course Lecture Schedules

Day	Chapter Topic	**Laboratory** (Meets on Mondays on HSEL 103)
1/17	***Martin Luther King Jr Holiday***	***Holiday - No Lab***
1/19	INTRODUCTION 1.1 Some Characteristics of Fluids 1.2 Dimensions, Dimensional Homogeneity and Units	
1/21	1.4 Measures of Fluid Mass and Weight	
1/24	1.5 Ideal Gas Law	Introduction, lab safety; use of statistics and spreadsheets
1/26	1.6 Viscosity	
1/28	1.7 Compressibility of Fluids	
1/31	1.8 Vapor Pressure (Cavitation) 1.9 Surface Tension	Lab 1. Measurement of fluid properties
2/02	2 FLUID STATICS 2.1 Pressure at a Point 2.2 Basic Equation for Pressure Field	
2/04	2.3 Pressure Variation in a Fluid at Rest 2.4 Standard Atmosphere	
2/07	2.5 Measurement of Pressure	Lab 2. Measurement of Viscosity
2/09	2.6 Manometry	
2/11	2.8 Hydrostatic Force on a Plane Surface	
2/14	2.9 Pressure Prism	Lab 3. Basic Manometry
2/16	2.10 Hydrostatic Force on a Curved Surface 2.10 (Continuation)	
2/18	2.11 Buoyancy, Flotation, Stability	
2/21	3 ELEMENTARY FLUID DYNAMICS—THE BERNOULLI'S EQN (BE) 3.1 Newton's Second Law 3.2 F = ma along a Streamline	Lab 4. Hydrostatic Forces – The Center of Pressure
2/23	**Celebr Knowldg 1 (Chapters 1.1-2.11)**	
2/25	3.3 F = ma Normal to a Streamline 3.4 Physical Interpretations and Alternate Forms of BE	
2/28	3.5 Static, stagnation, dynamic and total pressure	Lab 5. Archimedes principle and pascal apparatus.
3/02	3.6 Examples of Use of the Bernoulli Equation	
3/04	4 FLUID KINEMATICS 4.1 The Velocity Field	
3/07	4.2 The Acceleration Field	Fountain Pump Head Curve Measurement
3/09	4.3 Control Volume and System Representations 4.4 The Reynolds Transport Theorem	
3/11	5 FINITE CONTROL VOLUME ANALYSIS 5.1 Conservation of Mass—The Continuity Equation	
3/14	***Spring Break***	***Holiday - No Lab***
3/16	***Spring Break***	
3/18	***Spring Break***	
3/21	5.2 Newton's Second Law—The Linear Momentum Eqn	Lab 6. Flow measurement using pitot tube
3/23	5.2 (Continuation)	
3/25	5.3 First Law of Thermodynamics— The Energy Equation	
3/28	5.3 (Continuation)	Lab 7. The free jet -Curvilinear flow

3/30	7 DIMENSIONAL ANALYSIS, SIMILITUDE AND MODELING 7.1 The Need for Dimensional Analysis 7.2 Buckingham Pi Theorem 7.3 Determination of Pi Terms	
4/01	**Celebr Knowldg 2 (Chapters 3.1-5.3)**	
4/04	7.4 Additional Comments about Dimensional Analysis 7.6. Common Dimensionless Groups in Fluid Mechanics	Lab 8. Impact of Fluid Jet.
4/06	7.8. Modeling and Similitude	
4/08	8 VISCOUS FLOW IN PIPES 8.1 General Characteristics of Pipe Flow 8.2 Fully developed Laminar flow	
4/11	8.4 Dimensional Analysis of Pipe Flow Major and minor energy losses Pipe flowrate measurement	Flow in Pipes Theory and Fountain Calculations
4/13	8.4.3 Flow in non-circular conduits	
4/15	***Spring Holiday***	
4/18	8.5 Pipe Flow Examples	Lab 9. Major and Minor headlosses
4/20	6 DIFFERENTIAL ANALYSIS OF FLUID FLOW 6.1 Fluid Element Kinematics 6.2 Conservation of Mass	
4/22	6.3 The Linear Momentum Equation 6.4 Inviscid Flow 6.8 Viscous Flow	
4/25	6.9 Some Simple Solutions for Laminar, Viscous, Incompressible Flows	Work on Project
4/27	9.1 FLOW OVER IMMERSED BODIES 9.1 General External Flow Characteristics 9.1.1 Lift and Drag Concepts	
4/29	**Celebr Knowldg 3 (Chapters 7.1-6.9)**	
5/02	9.2 Boundary Layer Characteristics	Project Display (5/02 – 5/05)
5/04	9.2.6 Effects of Pressure Gradient	
5/06	9.3-9.4 Drag and Lift Examples	
5/09	**Final Celebr. Knowledge, 10:30 to 12:30 pm. Vin 287**	

End Notes

[1] https://www.angelo.edu/content/profiles/6462-aldo-r-pinon-villarreal
[2] https://ncees.org/engineering/fe/
[3] angelo.blackboard.com
[4] http://ncees.org/exams/calculator-policy/
[5] https://angelo.policystat.com/policy/10659448/latest/
[6] http://www.angelo.edu/student-handbook/
[7] https://www.angelo.edu/academics/catalog/
[8] https://www.angelo.edu/current-students/disability-services/
[9] https://www.angelo.edu/incident-form
[10] https://www.angelo.edu/title-ix
[11] https://angelo.policystat.com/policy/10659368/latest/
[12] https://www.angelo.edu/covid-19/
[13] https://www.angelo.edu/live/files/27603-student-handbook-2020-21#page=97
[14] http://www.angelo.edu/dept/writing_center/academic_honesty.php