



WHEELING JESUIT UNIVERSITY

Department of Engineering
Spring 2019

Course Title:	<u>FLUID MECHANICS</u>		
Course No.:	<u>EGR 347-01 (4 crs)</u>	Classroom:	<u>DON 108</u>
		Class Time:	<u>M-W-F 11:00-11:50 AM T 1:30-2:20 AM</u>
Prerequisite:	<u>EGR-317</u>		
Faculty:	<u>Neetika Sharma, Ph.D.</u>	Phone:	<u>304-243-2287</u>
Office Hours:	<u>DON-103 MWF 12:00-1:00 PM</u>	Email:	<u>nsharma@wju.edu</u>

Although the differences between solids and fluids can be explained qualitatively on the basis of molecular structure, a more specific distinction is based on how they deform under the action of an external load. Specifically, a fluid is defined as a substance that deforms continuously when acted on by a shearing stress of any magnitude. A shearing stress . . . is created whenever a tangential force acts on a surface . . .

Philip M. Gerhart, Andrew L. Gerhart, and John L. Hochstein

Fluid mechanics is the discipline within the broad field of applied mechanics that is concerned with the behavior of liquids and gases at rest or in motion. It covers a vast array of phenomena that occur in nature (with or without human intervention), in biology, and in numerous engineered, invented, or manufactured situations. There are few aspects of our lives that do not involve fluids, either directly or indirectly.

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COURSE DESCRIPTION

This course is designed for students learning about fluid mechanics for the first time and covers the basic concepts, laws, and techniques required to solve problems involving fluids. Concepts include fluid properties, hydrostatics, kinematics, pressure, pressure variation, the control-volume approach and the continuity equation, the momentum equation, the energy equation, dimensional analysis, and engineering applications of internal and external flows. Derivation of the governing equations. Application to hydrostatics, boundary layers, separation, wakes and drag, pipe flow, compressible flow, and introduction to turbomachinery (with emphasis on pumps). Normal shocks and isentropic flow. Prerequisite EGR 317

REQUIRED TEXTBOOKS

Elger, Donald F., Barbara A. Lebet, Clayton T. Crowe, and John A. Roberson. *Engineering Fluid Mechanics*. Hoboken, NJ: John Wiley & Sons, 2016. Eleventh edition.
ISBN: 978-1-118-88068-5

Articles and reports made available through Blackboard and Bishop Hodges Library.

STUDENT LEARNING OBJECTIVES

Upon successful completion of EGR 318, you will be able to:

1. Discuss the definition and basic properties of fluids, including density, pressure, temperature, and viscosity. (L)
2. Demonstrate the process and methods required to measure pressure. (M)
3. Apply principles of mechanics to determine the pressure distribution in a liquid under hydrostatic conditions. (M)
4. Use Euler's equation to determine pressure variation. (M)
5. Apply the Bernoulli equation along a streamline. (M)
6. Solve problems using the control-volume approach and the continuity equation, the linear momentum equation, and the energy equation. (M)
7. Apply dimensional analysis to problems involving fluids. (M)
8. Explain similitude and how it is used in modeling. (L)
9. Solve problems of viscous flow over a flat surface using the Navier-Stokes equations. (M)

EVALUATION METHODS

If you have completed all required assignments and barring violations of academic integrity, a pattern of disruptive behavior or more than eight absences, your final grade will be the weighted mean of the distribution described below.

Grade Distribution	
25%	Exam 1
25%	Exam 2
30%	Exam 3
20%	Chapter Assignments

After rounding off all decimals and under normal circumstances, I will use the scale outlined below to determine your final course grade.

Grading Scale							
94-100	A	83-86	B	73-76	C	60-65	D
90-93	A-	80-82	B-	70-72	C-	0-59	F
87-89	B+	77-79	C+	66-69	D+		

In addition to good class attendance and participation, passing this course requires you to complete successfully three exams and various chapter assignments. I may also make optional extra-credit assignments available. Following each exam, I will notify you in writing of your standing (grade) in the course.

Three Exams

Our course's exams are closed book, but open notes. Other than a scientific calculator, the use of electronic devices (tablet, laptop, desktop computer, smart phone, etc.) during exams is not permitted. The third exam will be the course's cumulative final exam. The questions in each exam will be similar to the chapter assignments and the problems discussed in class. As a general rule, bathroom breaks are not allowed during test taking.

Chapter Assignments

As we begin a particular chapter, I will assign a set of questions and exercises that will be due a few days later. Please carefully read and follow the assignment guidelines described.

Class Participation

I encourage and fully expect your on-time attendance and informed, focused participation in each class. To that end, please bring the textbook to class, sit in the same seat for the duration of the semester to expedite my record keeping, and avoid disruptive behavior, meaning any conduct that diminishes the learning environment of our classroom by distracting me or others—examples include talking, texting, surfing the web or merely giving the impression of doing so, using a messaging app, frequent tardiness, and recurring bathroom breaks.

Optional Extra-credit Assignments

As an opportunity to write an optional two-page reaction paper, I may suggest watching a particular broadcast, participating in an event, or attending a presentation on campus. Please note that, barring a major documentable emergency, I typically do not accept late papers. Submitting an extra-credit paper on time requires handing in a hard copy during the regularly scheduled class period in which it is due. Please write your papers on the template included in the course's Blackboard page and use Times New Roman 12-point font as well as standard margins. Your paper's line spacing should be no greater than two and no smaller than one

and a half. Submitting a handwritten hard copy or a paper containing overly faint, illegible typeface is unacceptable. Unacknowledged sources that are quoted directly or merely paraphrased are entirely inappropriate and will be considered plagiarism. I will add any extra-credit points you earn during the semester to your final-exam grade.

ASSIGNMENT GUIDELINES

I will strictly enforce these guidelines when grading your chapter assignments. Please let me know if you have questions or concerns about these guidelines.

- Hand in each assignment on time.
- For handwritten assignments, use engineering paper or unruled white $8\frac{1}{2} \times 11$ paper.
- Do not staple your work, but use a paperclip to keep the pages in order.
- The final answer with its correct units should be clearly indicated.
- Use a consistent method to show every major step of your work.
- Before plugging in any numbers, indicate clearly the formulas you are using.
- Explanations and reasons should be written legibly and in complete sentences.
- Present the problems in order and write your name on the front side of each page.
- When using Microsoft Excel, print the gridlines and headings with and without formulas.
- If you print a graph, include descriptive chart and axis titles with the appropriate units.
- I will not grade sloppy or illegible work.

ATTENDANCE POLICY

Regardless of your current year of study at the university (e.g., freshman, sophomore, etc.), **more than eight absences** or a pattern of disruptive behavior—such as frequent tardiness—will become a major factor in determining your final grade and can result in an FA (failure due to excessive absences). Please see me following the end of class if you arrive after I have taken attendance to insure that I have not recorded your tardiness as an absence. Please note that Wheeling Jesuit University does not distinguish between excused and unexcused absences, meaning every absence, regardless of your reasons for missing class, adds to your total number of absences.

Being Absent for an Exam or on a Due Date

If you are absent on the day of an exam or when an assignment is due in class, you should promptly provide me with an explanation and, if possible, suitable documentation showing that your absence was due to an illness or unforeseen emergency. Without such an explanation, your grade for the exam or assignment may be zero.

Student Athletes

If you are a student athlete, please provide me with your travel and game schedule ahead of time. For obvious reasons, this requirement becomes essential if your game schedule conflicts with any of our course's exams or due dates. Please note that student athletes in particular need to be vigilant about missing class since Wheeling Jesuit University does not distinguish between excused and unexcused absences.

DROPPING OR WITHDRAWING FROM THE COURSE

The last day of the Add/Drop period for this semester is Friday January 12, 2018. The last day to withdraw from a course with a grade of a W is Tuesday March 27, 2018.

DISABILITY STATEMENT

Wheeling Jesuit University offers students with documented disabilities individual accommodations on a case-by-case basis with confidentiality in compliance with the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973. Ultimately, all students are responsible for their own academic achievement and must attend classes, complete course assignments, and fulfill all university requirements for their chosen field of study. It is up to students with disabilities to seek out available assistance on campus and to utilize individualized accommodations. In order to receive accommodations under Section 504 and ADA, students with disabilities must self-identify to the university, provide current (within three years) and comprehensive documentation concerning the nature and extent of the disability, and communicate their needs to the Disability Services Director located in the ground level of Ignatius Hall, Room G24, or call 304-243-4484 before each semester begins.

ACADEMIC INTEGRITY STATEMENT

As an integral part of this course, I will strictly enforce the academic integrity policy of Wheeling Jesuit University (see www.wju.edu/studenthandbook). Sanctions for academic offenses include a "reduction in grade, or assignment of a failing grade, on the paper or examination in which the offense occurred."¹ Depending on the violation's severity, the penalty can also include failing the course regardless of one's previous grades. Cheating during an exam or test—for example, by

¹ <http://www.wju.edu/studenthandbook>.

using unauthorized sources—will result in a zero for that exam or test. Failing to cite all sources in a written assignment also constitutes a serious violation of academic integrity. These offenses can even result in dismissal from the university. I will inform the Faculty Academic Integrity Officer of each violation by filing an *Academic Integrity Citation Form* which will be added to the offending student's record. Although not intended to be an exhaustive list, the following constitute acts of academic dishonesty: plagiarism, deceit, cheating, fabricating data, the use of fictitious sources, the use of devices or sources not authorized by your instructor, and allowing another student to copy your paper, exam answers, or other work.

STUDENT EMAIL ACCOUNT AND BLACKBOARD

Please check your Wheeling Jesuit University email account every day since it is the primary means of communication used by this institution. I will use it to inform you of changes to our class schedule or to share other course-related information. You should also routinely check our course's Blackboard page since it will contain downloadable files related to the course's chapter assignments as well as links relevant to our course.

USE OF ELECTRONIC DEVICES IN CLASS

During class, please keep cell phones and other such devices in their silent mode. Unless approved by me ahead of time, please do not videotape or record our class lectures and discussions. Outside days devoted to exams, you may use a laptop, desktop computer, tablet or other similar electronic device with internet connectivity provided you restrict your use to course-related purposes, such as note taking, viewing documents that we are discussing in class, or working on a chapter assignment. Your final course grade will suffer if you surf the web, use a messaging app, or merely give the impression of doing so. Other than a scientific calculator, you may not use or even have with you any other kind of electronic device (tablet, laptop, desktop computer, smart phone, etc.) while taking an exam. If you use such a device during any kind of test taking, you will receive a zero for the exam and I will file an *Academic Integrity Citation Form* which will be added to your student record and could lead to other sanctions.

ACADEMIC RESOURCE CENTER

The Academic Resource Center (ARC) is a totally free academic-support service available to all enrolled Wheeling Jesuit University students and staffed almost exclusively by WJU students

recommended for employment by WJU faculty. The ARC is located in Bishop Hodges Library and is open five days a week:

Sundays 6:00-8:00 PM

Mondays-Thursdays 1:00-9:00 PM

Please visit the ARC's website (readily accessible on the Cardinal homepage under "Quick Links" or as the first listing under "Student Services") to learn about the ARC's services (emphasizing writing, math, and the sciences) and to schedule appointments.

SUCCEEDING IN THIS COURSE

Your chances of succeeding in this course and fruitfully understanding the assigned topics are greatly enhanced if you aim to: **(1)** arrive on time, take meticulous notes during class, offer informed comments or questions, and work consistently on the chapter assignments; **(2)** read diligently the course's assigned chapters and bring the textbook to class every day; **(3)** abide by the norms of academic integrity; and **(4)** avail yourself, as needed, of my help or that of Fr. Tampe, and of the services provided by the Bishop Hodges Library, the Academic Resource Center or ARC (located in the Bishop Hodges Library; 304-243-4473), Disability Services (Ignatius Hall G24; 304-243-4484), the Health Center (McDonough 219; 304-243-2275), and the Counseling Center (Ignatius Hall G23; 304-243-2081). I am happy to help you: please call or email me if you have questions. Please be proactive: let me know as soon as possible of any special circumstances or difficulties that could potentially affect your class attendance or even your final course grade.

COURSE OUTLINE

A summary of important dates is included below. Because due dates and the order of topics may vary during the course of the semester, please contact your classmates in the event of an absence to make up for missed work.

Important Dates	
January	Mon 7 Start of Semester Fri 11 Last Day to Add/Drop
February	Fri 8 Exam 1 Mon 11 Advisory Grades
March	4 - 10 Spring Break Fri 22 Exam 2 Tues 26 Last Day to Withdraw with a Grade of W
April	18 - 22 Easter Break Fri 26 Last Day of Classes Tues April 30 Final Exam 2:00 PM to 4:30 PM