

Syllabus for EGM-3310

FLUID MECHANICS

COURSE DESCRIPTION

This course covers fundamental fluid statics, including manometer, forces on submerged surfaces, and Archimedes' principle. Details of the course include one-dimensional incompressible flow; conservation laws and application to flowing systems, cavitation, impulse-momentum problems, vanes; and pipe flows, laminar analysis, turbulent flows with emphasis on calculation of fluid properties. Other topics include one-dimensional compressible flow; conservation laws; specialization to isentropic situation; and nature of speed of sound. Applications, including effects of area change, converging and diverging nozzles, choking phenomenon, and normal shock waves.

Fluid Mechanics is defined as the science that deals with the behavior of fluids at rest (fluid statics), fluids in motion (fluid dynamics), and the interaction of fluids with solids or other fluids at the boundaries.

Recall that stress is defined as force per unit area. The normal (perpendicular) component of a force acting on a surface per unit area is called the normal stress and for a fluid at rest, is known as pressure. The tangential (parallel) component of a force acting on a surface per unit area is called shear stress. A fluid at rest is at a state of zero shear stress.

To begin, we must first understand what is called the no-slip condition between some fluid and a solid surface (which is the development of boundary layers between the two). Next, we classify various types of fluid flow (viscous versus inviscid regions of flow, internal versus external flow, compressible versus incompressible flow, laminar versus turbulent flow, natural versus forced flow, and steady versus unsteady flow). Fluid properties, such as vapor pressure and viscosity, and boundary properties, such as surface tension, are discussed and used to describe various fluid flow problems encountered in practice.

In studying fluid statics, hydrostatic forces acting on submerged bodies are considered. The buoyant force applied by fluids on submerged or floating bodies and the stability of such bodies are examined.

Bernoulli's equation is derived by applying Newton's second law to a fluid element along a streamline. The conservation of kinetic, potential, and flow energies of a fluid, where viscous forces are negligible, results in an energy equation that is used in a variety of applications.

To solve fluid flow problems fast and simply, without a significant loss of accuracy, a finite control volume momentum analysis is presented. Using Reynolds transport theorem and Newton's laws, the linear and angular momentum equations for control volumes are developed. These are used to determine the forces and torques associated with fluid flow.

Flow through pipes and ducts, including entrance region and the fully developed region, is analyzed. The pressure drop associated with fluid flows is used to determine pumping power requirements for various

pipng systems.

External flow, which is flow over bodies that are immersed in a fluid, results in lift and drag forces. Analysis of the velocity boundary layer formed when there is parallel flow over various surfaces provides relations for skin friction and drag coefficients. The lift developed by airfoils and factors that affect the lift characteristics of bodies are discussed.

COURSE TOPICS

- Fluid mechanics—basics
- Fluid statics
- Bernoulli and energy equations
- Momentum analysis of flow structures
- Internal flow
- External flow: drag and lift

COURSE OBJECTIVES

After completing this course, you should be able to:

- CO1** Classify fluid flow in terms of fluid properties, including viscosity, vapor pressure, velocity fields, surface tension, capillary effect, and cavitation.
- CO2** Explain how hydrostatic forces act on submerged plane and curved surfaces and account for buoyancy and stability effects.
- CO3** Use data from manometers such as the piezometer tube, the U-tube, or the pitot-static tube to measure pressure differences and determine flows.
- CO4** Derive Bernoulli's equation for steady, inviscid, incompressible flow using Newton's second law and conservation of energy principle.
- CO5** Use Bernoulli's equation to solve problems involving confined flows, free jets, and flow-rate measurements (orifice, nozzle, venturi meter).
- CO6** State Reynolds transport theorem for flow (steady and unsteady) through a control volume.
- CO7** Solve fluid flow problems where the flow is steady or unsteady using the continuity equation and a fixed, non-deforming control volume.
- CO8** Distinguish between laminar flow and turbulent flow in pipes.

- CO9** Solve fluid flow problems using different piping networks.
- CO10** State the three pump laws for centrifugal pumps and apply them to pump situations.
- CO11** Explain the concept of drag and lift for flows over plane, cylindrical, and spherical surfaces.
- CO12** Describe how friction and pressure drag affects fluid flows inside and outside various fixed, non-deforming geometrical shapes.

COURSE MATERIALS

You will need the following materials to complete your coursework. Some course materials may be free, open source, or available from other providers. You can access free or open-source materials by clicking the links provided below or in the module details documents. To purchase course materials, please visit the [University's textbook supplier](#).

Required Textbooks

- Cengel, Y. A., Turner, R. H., & Cimbala, J. M. (2017). *Fundamentals of thermal-fluid sciences* (5th ed.). New York, NY: McGraw-Hill.
ISBN-13: 978-0078027680
- [Note: This course will cover Part 2 of this book. This book is also used in EGM-221: Thermodynamics and EGM-323: Heat Transfer.]
- Giles, R. V., Evett, J. B., & Liu, C. (2013). *Schaum's outline of fluid mechanics and hydraulics* (4th ed.). New York, NY: McGraw-Hill.
ISBN-13: 978-0071831451

Resources

For those students who have not applied their Calculus I knowledge recently, the following web-linked math tutorials are recommended for refresher.

- **Fundamentals:** [S.O.S. Mathematics: Calculus](#)
- **Graphics:** [Graphics for the Calculus Classroom](#)
- **Graphing calculator:** [GraphCalc](#)
- **Resource list:** [Calculus.org](#)
- **Sample problems:** [Calculus on the Web](#)

- **Videos and visual aids:**
 - [Calculus-Help](#)
 - [Khan Academy](#)
 - [Larry Green's Calculus Videos](#)
 - [MathTV](#)
 - [Visual Calculus](#)

COURSE STRUCTURE

Fluid Mechanics is a three-credit, online course consisting of **six** modules. Modules include an overview, topics, study materials, and activities. Module titles are listed below.

- **Module 1: Introduction to Fluid Mechanics**
Course objectives covered in this module: CO1
- **Module 2: Fluid Statics**
Course objectives covered in this module: CO2
- **Module 3: Bernoulli and Energy Equation**
Course objectives covered in this module: CO3, CO4, CO5
- **Module 4: Momentum Analysis of Flow Structures**
Course objectives covered in this module: CO6, CO7
- **Module 5: Internal Flow**
Course objectives covered in this module: CO8, CO9, CO10
- **Module 6: External Flow: Drag and Lift**
Course objectives covered in this module: CO11, CO12

ASSESSMENT METHODS

For your formal work in the course, you are required to participate in six online discussion forums, complete six application exercises, and take a proctored midterm and final exam. See below for more details.

Consult the Course Calendar for assignment due dates.

Promoting Originality

One or more of your course activities may utilize a tool designed to promote original work and evaluate

your submissions for plagiarism. More information about this tool is available in [this document](#).

Discussion Forums

You are required to complete **six** discussion forum assignments. Discussion forums are on a variety of topics associated with the course modules.

For posting guidelines and help with discussion forums, please see the Student Handbook located within the General Information page of the course website.

Application Exercises

You are required to complete **six** application exercises. The application exercises are on a variety of topics associated with the course modules.

For help regarding preparing and submitting assignments, see the Student Handbook located within the General Information page of the course website.

Examinations

You are required to take **two** proctored online examinations. The exams require that you use the University's [Online Proctor Service](#) (OPS). Please refer to the "Examinations and Proctors" section of the Online Student Handbook (see [Student Handbooks](#) in the General Information area of the course website) for further information about scheduling and taking online exams and for all exam policies and procedures. You are strongly advised to schedule your exams within the first week of the semester.

Online exams are administered through the course website. Consult the Course Calendar for the official dates of exam weeks.

Midterm Examination

Note: For a list of key concepts that may appear on your exam, refer to the study guide available in the Examinations section of the course website.

The midterm examination is an open-book, 3-hour exam worth 20 percent of your course grade. It will consist of eight problems to solve and will cover all topics and material from Modules 1 through 3 of the course. You can use your book, a scientific, graphing, or financial calculator (no phones or tablets), and scratch paper during the exam.

Final Examination

Note: For a list of key concepts that may appear on your exam, refer to the study guide available in the Examinations section of the course website.

The final examination is an open-book, 3-hour exam worth 20 percent of your course grade. It will consist of eight problems to solve and will cover all topics and material from Modules 4 through 6 of the course. You can use your book, a scientific, graphing, or financial calculator (no phones or tablets), and scratch paper during the exam.

Statement about Cheating

You are on your honor not to cheat during the exam. Cheating means:

- Looking up any answer or part of an answer in an unauthorized textbook or on the Internet, or using any other source to find the answer.
- Copying and pasting or in any way copying responses or parts of responses from any other source into your online test. This includes but is not limited to copying and pasting from other documents or spreadsheets, whether written by yourself or anyone else.
- Plagiarizing answers.
- Asking anyone else to assist you by whatever means available while you take the exam.
- Copying any part of the exam to share with other students.
- Telling your mentor that you need another attempt at the exam because your connection to the Internet was interrupted when that is not true.

If there is evidence that you have cheated or plagiarized in your exam, the exam will be declared invalid, and you will fail the course.

GRADING AND EVALUATION

Your grade in the course will be determined as follows:

- **Online discussions (6)**—20%
- **Application exercises (6)**—40%
- **Midterm exam**—20%
- **Final exam**—20%

All activities will receive a numerical grade of 0–100. You will receive a score of 0 for any work not submitted. Your final grade in the course will be a letter grade. Letter grade equivalents for numerical grades are as follows:

A	= 93–100	C+	= 78–79
A–	= 90–92	C	= 73–77
B+	= 88–89	C–	= 70–72

B	= 83–87	D	= 60–69
B–	= 80–82	F	= Below 60

To receive credit for the course, you must earn a letter grade of C or better (for an area of study course) or D or better (for a course not in your area of study), based on the weighted average of all assigned course work (e.g., exams, assignments, discussion postings).

STRATEGIES FOR SUCCESS

First Steps to Success

To succeed in this course, take the following first steps:

- Read carefully the entire Syllabus, making sure that all aspects of the course are clear to you and that you have all the materials required for the course.
- Take the time to read the entire Online Student Handbook. The Handbook answers many questions about how to proceed through the course and how to get the most from your educational experience at Thomas Edison State University.
- Familiarize yourself with the learning management systems environment—how to navigate it and what the various course areas contain. If you know what to expect as you navigate the course, you can better pace yourself and complete the work on time.
- If you are not familiar with web-based learning, be sure to review the processes for posting responses online and submitting assignments before class begins.

Study Tips

Consider the following study tips for success:

- To stay on track throughout the course, begin each week by consulting the Course Calendar. The Course Calendar provides an overview of the course and indicates due dates for submitting assignments and posting discussions.
- Check Announcements regularly for new course information.

Using AI Ethically: A Guide for TESU Students

TESU's [Academic Code of Conduct](#) permits student AI use in support of their writing and research process—not as a replacement for original writing. Document AI use with an acknowledgment statement at the end of each assignment, noting the tools and prompts used. Cite any AI-generated content on the References page. Please review [Using AI Ethically: A Guide for TESU Students](#) for more detailed information.

COMMITMENT TO DIVERSITY, EQUITY, AND INCLUSION

Thomas Edison State University recognizes, values, and relies upon the diversity of our community. We strive to provide equitable, inclusive learning experiences that embrace our students' backgrounds, identities, experiences, abilities, and expertise.

ACCESSIBILITY AND ACCOMMODATIONS

Thomas Edison State University adheres to the Americans with Disabilities Act (ADA, 1990; ADAAA, 2008) and Section 504 of the Rehabilitation Act of 1973. The Office of Student Accessibility Services (OSAS) oversees requests for academic accommodations related to disabilities; a student who is pregnant, postpartum, or a student parenting a newborn who is not the birth parent [as covered under NJSA18A]; and students requesting academic accommodation for a short-term/temporary illness and/or injury. Information can be found on the [Office of Student Accessibility Services](#) webpage and questions can be sent to ADA@tesu.edu.

ACADEMIC POLICIES

To ensure success in all your academic endeavors and coursework at Thomas Edison State University, familiarize yourself with all administrative and academic policies including those related to academic integrity, course late submissions, course extensions, and grading policies.

For more, see:

- [University-wide policies](#)
- [Undergraduate academic policies](#)
- [Undergraduate course policies](#)
- [Graduate academic policies](#)
- [Graduate course policies](#)
- [Nursing student policies](#)
- [Nursing graduate student policies](#)
- [International student policies](#)
- [Academic code of conduct](#)