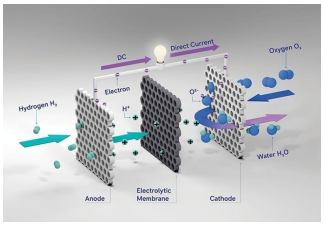
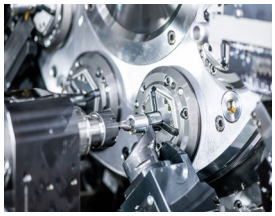


MECH-322 Fluid Mechanics



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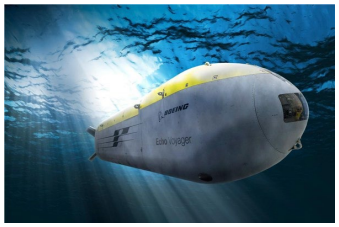
Student Learning Document



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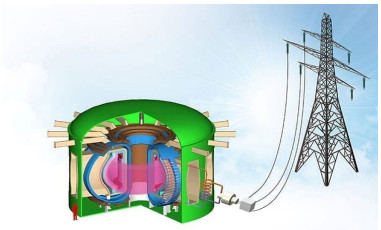

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"Those who know ***HOW*** to think will surpass those who only know ***WHAT*** to think"?

World-renowned Astrophysicist

Neil deGrasse Tyson

FOREWORD

As engineering students select to study engineering disciplines and to understand the '***PATH***' to innovation and problem solving, it is prudent to have a high-level definition of the career field. The document herein provides an overview of ***"What is Mechanical Engineering***" and a definition of ***Fluid Mechanics*** within the study of Mechanical Engineering. Through the understanding of "***what***" is being studied, "***how***" to think and to approach problem solving, and its relevance to the general framework of engineering, perhaps will lead to an increased underlying understanding and interest of the presented topics.

The 'PATH' to problem solving success is NOT driven by merely applying arbitrary engineering equations without a knowledge of "what" are the variables, "how" the variables relate to each other, "what" are the units of BOTH the equation and the variables, "what" is the expected outcome of the equation, and "when" is it appropriate to apply the equation?

TEACHING PHILOSOPHY

In the next 25 years the world will: develop a cure for cancer, reach out and start to colonize other planetary worlds, discover new nanomaterials that will forever change our understanding of physics, start to control and hopefully reverse the ravages of global warming and climate change, develop quantum machines to interface with human biological processes, provide the world with limitless and clean energy, be able to see further back into the past than ever imagined, and we will begin to understand the origins of everything.

Engineering design is the execution of applied physics for the development of technical solutions for challenges facing the survival of mankind, and the technical communication of those solutions. The challenge for academic leaders is that we are faced with the unnerving reality that we teach concepts and present materials that have not changed for 100+ years. We are challenged, however, to solve problems that we cannot imagine today, and to prepare students to develop and to use tools based upon concepts that have not been conceived.

We live in a daunting academic environment, and the only solution is to focus on student development that embraces discovery and inquiry. We must develop a mindset that rejects being told all the answers and to alternatively develop a mindset that expects to be challenged and to understand that it's "ok" to not know all the answers. The most important skill that we can impart to students is to develop an understanding of the Process and Roadmap to find and to understand answers to unknown problems and questions, that we can only dream about today. It will be these students and these institutions that will contribute to the long-term universal expansion and survival of humankind.

Often there are discussions regarding the development of independent thinkers and how to achieve the development of the independent mindset. This is never achieved by providing all the questions and all the answers, all the time! Researchers expect that at the beginning of any research endeavor, no one will know all the problems nor have all the answers. The hallmark of the independent mind is a problem-solving mentality, focused on the necessity to self-learn, and combined with an ability

to interpolate and extrapolate data to form conclusions with the fortitude to be unafraid to seek validation from multiple independent sources.

The focus of Dr. Berry in response to these challenges is to help student engineers transcend from an environment of simply "***getting an answer***" yet without a regard for the process or "***path***", or result confirmation, to a learning environment where Parametric Thought allows the formulation of mental solution pathways before putting pen-to-paper while ensuring solution validity and technical structure.

ABET STUDENT OUTCOMES (SO)

Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program.

WHAT is the Definition of Mechanical Engineering?

Mechanical engineering is the study of physical machines that may involve force and movement. It is an engineering branch that combines engineering physics and mathematics principles with materials science, to design, analyze, manufacture, and maintain mechanical systems.

Mechanical Engineering is the oldest and broadest of engineering disciplines. In short, it includes the design of machines that move and have notion, and the conversion of energy to do work. The discipline of energy conversion is referred to Energy Systems Design, or Thermal Fluid Systems Design, and is comprised of course work in the topical areas of Thermodynamics, Fluid Mechanics, and Heat Transfer.

The conversion of energy into useful power and the efficiency of the process is the definition of **Thermodynamics**.

Undergraduate **Fluid Mechanics** is the discipline within the broad field of applied mechanics and applied physics, that is concerned with the behavior of liquids and gases at rest or in motion; including pressure drops from fluid flow and aerodynamic drag forces.

Undergraduate **Heat Transfer** is the discipline within Thermal Fluid Systems that governs the time rate of change of the energy transfer process and defines the thermal mechanisms that cause the process state change within **Thermodynamics.**

Mechanical Engineering SO's

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

3. An ability to communicate effectively with a range of audiences.

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Within each of the SO's above students taking MECH-322 Fluid Mechanics will focus on the following ***Student Learning Objectives (SLO's)*** relative to each Program ABET SO:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

    a. *Classify different types of fluid motion.*
    b. *Identify different flow regimes.*
    c. *Evaluate flow characteristics by solving engineering problems and to be able to correctly represent flow solution with correct engineering units.*
    d. *Determine pressure distribution in fluids at rest and calculate hydrostatic forces acting on plane surfaces.*
    e. *Determine acceleration of the fluid for steady and unsteady flows.*
    f. *Apply the control volume and control surface concept to solve engineering problems through the application of conservation of mass, momentum, and energy.*

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

    a. *Ability to design and solve fluid flow-oriented engineering systems considering safety, environmental and economic factors.*

3. An ability to communicate effectively with a range of audiences.

    a. *Ability to effectively communicate, present and write team project reports.*
    b. *Be able to correctly represent flow solution with correct engineering units.*

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

    a. *Ability to use fluid flow equation, pressure variation, flow rate measurement to solve engineering problems.*

b. *Calculate velocity, power added to the fluid using mass, momentum and energy equations.*
c. *Apply the basic principles to the viscous pipe flows, multiple piping systems and ducts to determine friction losses, and shear stress.*
d. *Utilize fluid flow knowledge to analyze external flows, and to calculate drag and lift forces acting on immersed bodies.*
e. *Study the compressibility effect on steady, isentropic, one-dimensional flow of an ideal gas in varying cross-sectional area duct.*

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

    a. *Evaluate team project/industry standard problem/device performance by applying knowledge learned in the course study through step-by-step solution strategy.*

As the course material is presented, every effort will be made to link lecture AND exam problems to assigned homework problems and ABET student learning objectives.

WINTER 2023 FLUID MECHANICS STUDENT:

"Now we must focus on the social responsibility of engineers to solve the global warming problem. First, we must define our knowns, the first being social responsibility. Social responsibility is according to Investopedia, a theory that businesses must act to help society not just their pocketbooks. This definition can be applied to engineers as well. It is something that should be in fact hardwired into every human's brain in my opinion. Caring about others around you is what makes a person good or not, if someone cares only about money, they are most likely not the person that is wanted to be called upon to save the world because they will refuse. Therefore, with my view that all people should care about people, I believe that there is very much a social responsibility of engineers to solve the global warming problem. Although, it cannot be solved by just engineers, there is definitely a use for the engineers in solving this problem therefore there is an obligation to help. There is a moral obligation and social responsibility for engineers to help with solving the problem that is global warming."

MECHANICAL ENGINEERING AND CLIMATE CHANGE

(2023 HOTTEST GLOBAL TEMPERATURES IN 100,000 YEARS (CLICK))

Every year, millions of Americans lose power frequently and for long durations due to snowstorms, hurricanes, and wildfires. Scientists around the globe believe an increased occurrence of severe weather events is related to climate change - climate change that is a direct result of our 21st century way of life. To help students understand our engineering and social responsibility students often submit their personal 3–5-page essay at the end of the course relating to views on the importance of engineering and fluid mechanics to ensuring the survival of mankind. Here is an excerpt from a Winter 2023 Fluid Mechanics student:

What will your comments be regarding engineering social responsibility regarding climate change? To see prior students' essays, click HERE.

TIPS FOR SUCCESS

Below are a few tips for success not only within Fluid Mechanics, but within any engineering course.

- ✓ Class Attendance—Success is often linked directly to coming to class.
- ✓ Commit to 2.5 hours per night to review reading assignments, PowerPoint lectures.
- ✓ Commit to understanding the value of taking notes directly onto PowerPoint lecture slides.
- ✓ Commit to completing 3-4 problems nightly, but not to just get an answer, but to focus on the "process" of applying the engineering fundamentals. An answer is meaningless if the "how" and the "why" is not clear.
- ✓ Commit to understanding that engineering problem solving success can't happen without ***PRACTICE, PRACTICE, PRACTICE.***
- ✓ Commit to learning definitions that drive the understanding of fluid fundamentals. This is the initial step to understanding the "PATH". Take advantage of QUIZLET.com to help boost your understanding and recall.
- ✓ Commit to attending weekly Wednesday 8:30 AM LC Q/A session if there are ANY questions at all.
- ✓ Commit to reaching out and requesting 1-on-1 ZOOM or EMAIL help at any time and any day.
- ✓ Commit to reviewing and re-doing provided Study Aids, handouts, and quizzes prior to major Exams.
- ✓ Commit to trusting the "PATH" as defined to help you understand the problem solving methodology process such that as you grow in process thought maturity, problems and geometry become irrelevant.

To understand what a few prior students had to say regarding **TIPS for SUCCESS**, click **HERE**.

EXAM SCHEDULE

To provide clarity regarding exams, the schedule is as follows:

- EXAM I: FRIDAY WEEK #5, 2 Hours 15 Minutes, 100 Points
- EXAM II: FRIDAY WEEK #10, 2 Hours 15 Minutes, 100 Points
- FINAL EXAM: WEDESDAY WEEK #11, 2.5 Hours, 120 Points

Any other in-class quizzes or take-home projects or other assignments will be announced in class.

SINGLE MOST IMPORTANT SKILL SET TAUGHT TO ASSIST YOUR ENGINEERING CAREER?

> *"The importance of units, including units through the entire process, will result in far less error than simply adding a unit at the end of the problem. The process is more important than the correct answer, and this is the first time the process was more important than a correct answer. In the workplace, processes are crucial to succeeding. Without a process and controls in the workplace, your errors can result in severe injury and death."*
>
> *…WINTER 2023 Fluid Mechanics Student*

> *"The single most important skill set Dr Berry has instilled unto me was the importance of process over the geometry of a problem. Armed with knowledge and new way of thinking, no problem, whether it be in school or at work is insurmountable. Breaking problems down into their pieces and fundamentals will allow us to not only solve problems easier but improve upon them. "*
>
> *…WINTER 2023 Fluid Mechanics Student*

ADDITIONAL INFORMATION:

- **MECH-322 SYLLABUS**
- **HOMEWORK AND READING ASSIGNMENTS**