

Spring 2022

MECH 4316 - THERMAL SYSTEM DESIGN - (CRN:22120)

Course Description	Design, analysis, and optimization of fluid flow, heat transfer and energy processes of ducts and piping, heat exchangers, fluid machinery, power generation and environmental control systems. Use of computational fluid dynamics (CFD) tools to synthesize thermo-fluid system designs. <i>Prerequisite is MECH 4315 with a grade of “D” or better.</i>
Instructor	Miguel Cedeno, Ph.D. Assistant Professor of Instruction Aerospace and Mechanical Engineering <i>E-mail address:</i> macedenomor@utep.edu <i>Office:</i> Engineering Building Room E-330 <i>Office hours:</i> TR 3 – 4 pm (In Person) <i>Office phone:</i> (915)-747-7976 Teaching Assistant: TBA TBA@miners.utep.edu Office Hours: By appointment.
Reference Textbooks	No textbook is required for the course. I will be making use of the following texts in some lectures I will give during the semester. <i>Fundamentals of Thermal-Fluid Sciences</i> Fifth Edition (2017) by Yunus Cengel, John Cimbala, and Robert Turner McGraw Hill <i>Fluid Mechanics: Fundamentals and Applications</i> Fourth Edition (2018) by Yunus Cengel and John Cimbala McGraw Hill <i>Heat and Mass Transfer</i> Fifth Edition (2019) by Yunus Cengel and Afshin Ghajar McGraw Hill
Course Content	1. Analytical Solutions a. Heat Exchangers b. Flow Over a Heated Cylinder 2. CFD a. Navier-Stokes Equations b. Introduction to Fluent (See attached video lecture list) 3. Engineering Design, Build, Test a. Thermal Fluid Systems

Grading	Quizzes	100
	Peer Evaluation	60
	Projects	340
	Possible Points	500

A (500-450): B (449-400): C (399-350): D (349-300): F (299 and Below)

There will be four quizzes and two projects. There will be no makeups for the quizzes.

Major Course Objective This course is a capstone type of course in the energy systems (or thermal sciences) area. It corresponds to the mechanical design course in the Mechanical Systems area. The course is intended for senior Mechanical Engineering students who intend to practice in the fluid/thermal area.

ABET Program Outcomes Impacted This class significantly addresses the following ABET objectives:
 (a) an ability to apply knowledge of mathematics, science, and engineering
 (b) an ability to design and conduct experiments, as well as to analyze and interpret data
 (e) an ability to identify, formulate, and solve engineering problems

Course Communication: *How we will stay in contact with each other*

- **Office Hours:** We will be able to meet on campus. My office hours are listed on the syllabus. This is the fastest way to get your issues solved. You do not need to make an appointment; you are welcome to stop by the office during my office hours.
- **Email:** UTEP e-mail is the best way to contact me. I will make every attempt to respond to your e-mail within 24-48 hours of receipt. When e-mailing me, **be sure to email from your UTEP student email and please put the course number in the subject line.** In the body of your e-mail, start with greetings and clearly state your question. At the end of your e-mail, be sure to put your first and last name, and your UTEP ID.
- **Announcements:** Check the Blackboard/MS Teams announcements frequently for any updates, deadlines, or other important messages.

TECHNOLOGY REQUIREMENTS

You will need to have access to a computer/laptop, scanner, a webcam, and a microphone. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and Java. Check that your computer hardware and software are up-to-date and able to access all parts of the course.

If you do not have a word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook and more) for free via UTEP's Microsoft Office Portal. Click the following link for more information about [Microsoft Office 365](#) and follow the instructions.

IMPORTANT: If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP [Help Desk](#) as they are trained specifically in assisting with technological needs of students. Please do not contact me for this type of assistance. The Help Desk is much better equipped than I am to assist you!

NETIQUETTE

As we know, sometimes communication online can be challenging. It's possible to miscommunicate what we mean or to misunderstand what our classmates mean given the lack of body language and immediate feedback. Therefore, please keep these netiquette (network etiquette) guidelines in mind. Failure to observe them may result in disciplinary action.

- Always consider audience. This is a college-level course; therefore, all communication should reflect polite consideration of other's ideas.
- Respect and courtesy must be always provided to classmates and to the instructor. No harassment or inappropriate postings will be tolerated.
- When reacting to someone else's message, address the ideas, not the person. Post only what anyone would comfortably state in a face-to-face situation.
- **Blackboard is not a public internet venue;** all postings to it should be considered private and confidential. Whatever is posted on in these online spaces is intended for classmates and professor only. *Please do not copy documents and paste them to a publicly accessible website, blog, or other space such as Chegg.*

Course Policies: *What do you need to do to be successful in the course*

Attendance and participation

Attendance in the course is determined by participation in the learning activities of the course. Your participation in the course is important not only for your learning and success but also to create a community of learners. Participation is determined by completion of the following activities:

- Reading/Viewing all course materials to ensure understanding of assignment requirements
- Other activities as indicated in the weekly modules such as YouTube Tutorials and ANSYS Tutorials

These activities are designed to contribute to your learning each week

EXCUSED ABSENCES AND/OR COURSE DROP POLICY

See academic regulations in the UTEP Undergraduate Catalog for a list of excuse absences. If you feel that you are unable to complete the course successfully, please let me know and then contact the Registrar's Office to initiate the drop process **BEFORE DROP DEADLINE** (Listed on the Schedule). If you do not, you are at risk of receiving an "F" for the course. **AFTER DROP DEADLINE**, you can reach out to me, then we will meet with the Undergraduate Advisor (Dr. Abed) or Iliana Solis, to verify if your case is qualified for me to drop from the class with a grade of "W".

Academic dishonesty

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test (Chegg), or falsifying research data on laboratory reports.

Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All *suspected violations* of academic integrity at The University of Texas at El Paso will be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit [HOOP: Student Conduct and Discipline](#).

Reasonable Accommodation Policy: The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the [UTEP Center for Accommodations and Support Services](#) (CASS). Please note that (CASS) is using a new Software System called AIM (CASS Portal). This portal provides you with access to letters of notification and the ability to fill out your CASS Alternative Testing Agreement form. Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at cass@utep.edu, or apply for accommodations online via the [CASS portal](#).

Quizzes proctoring

Quizzes will be taken on campus with TA proctoring them.

Plagiarism detecting software

Some of your course work and assessments may submitted to SafeAssign, a plagiarism detecting software. SafeAssign is used review assignment submissions for originality and will help you learn how to properly attribute sources rather than paraphrase.

Copyright statement for course materials

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

COVID-19 PRECAUTIONS

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID 19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way

that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org

Please note that if COVID-19 conditions deteriorate again in the City of El Paso, all course and lab activities may be transitioned to remote delivery.

Course Resources: Where you can go for assistance

UTEP provides a variety of student services and support:

Technology Resources

- [Help Desk](#): Students experiencing technological challenges (email, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. Contact the Helpdesk via phone, email, chat, website, or in person if on campus.

Academic Resources

- [UTEP Library](#): Access a wide range of resources including online full-text access to thousands of journals and eBooks plus reference service and librarian assistance for enrolled students.
- [University Writing Center \(UWC\)](#): Submit papers here for assistance with writing style and formatting, ask a tutor for help and explore other writing resources.
- [Math Tutoring Center \(MaRCS\)](#): Ask a tutor for help and explore other available math resources.
- [RefWorks](#): A bibliographic citation tool; check out the RefWorks tutorial and Fact Sheet and Quick-Start Guide.

Individual Resources

- [Military Student Success Center](#): Assists personnel in any branch of service to reach their educational goals.
- [Center for Accommodations and Support Services](#): Assists students with ADA-related accommodations for coursework, housing, and internships.
- [Counseling and Psychological Services](#): Provides a variety of counseling services including individual, couples, and group sessions as well as career and disability assessments.

Department of Aerospace and Mechanical Engineering Safety Statement

The Department of Aerospace and Mechanical Engineering at the University of Texas at El Paso is committed to a model of excellence in education that includes providing a safe and healthy environment for its students, staff, faculty, and the public.

Our goal is to maximize education and research training that can only occur if you, the individual, minimize hazards and risks. This can be done by:

- Providing adequate control of the health and safety risks arising from all activities.
- Consulting with employees on matters affecting their health and safety
- Providing and maintaining safe laboratories and equipment.
- Ensuring safe handling and use of substance.
- Ensuring all employees are competent to do their task and have adequate training; and
- Maintaining clean, safe, and healthy working conditions

The principal investigator or individual in charge of each laboratory is ultimately responsible for safety in that respective lab. This includes training and ultimate release of the laboratory. Within the Department, we hold every employee (staff, faculty, student) responsible for implementing our safety practices and our departmental safety policy. We hold every employee (staff, faculty, student) responsible for providing leadership within our department to establish effective environmental safety and occupational health standards.

CLASS SCHEDULE
MEETING TIME: TR 1330-1450
MEETING LOCATION: Liberal Arts Building 108

Week	Dates	Topic(s)	Scheduled and DUE
1	Tuesday, January 18, 2022	Introduction	-
	Thursday, January 20, 2022	Heat Exchanger Types	-
2	Tuesday, January 25, 2022	Overall Heat Transfer Coefficient	-
	Thursday, January 27, 2022	Log Mean Temperature Difference (LMTD) Method	Quiz 1 Covering Overall Heat Transfer Coefficient
3	Tuesday, February 1, 2022	Log Mean Temperature Difference (LMTD) Method Cont.	-
	Thursday, February 3, 2022	The NTU Method	Quiz 2 Covering LMTD Method
4	Tuesday, February 8, 2022	The NTU Method Cont.	Project 1 (Posted on BB)
	Thursday, February 10, 2022	Continuity Equation Momentum Equation including Cauchy's and Navier-Stokes Equations	Quiz 3 Covering NTU Method
5	Tuesday, February 15, 2022	Introduction to ANSYS Fluent	In-class exercises and practice with Fluent

	Thursday, February 17, 2022	ANSYS Fluent in Class Lectures	**Please see video list at end of this document**
6	Tuesday, February 22, 2022	ANSYS Fluent in Class Lectures	Project 2 (Posted on BB)
	Thursday, February 24, 2022	ANSYS Fluent in Class Lectures	Work on Project 1 In-class exercises Watch Videos
7	Tuesday, March 1, 2022	ANSYS Fluent in Class Lectures	Work on Project 1 In-class exercises Watch Videos
	Thursday, March 3, 2022	-	Quiz 4 Covering CFD
8	Tuesday, March 8, 2022	STARCCM+ In Class Lectures	-
	Thursday, March 10, 2022	STARCCM+ In Class Lectures	SUBMIT PROJECT 1 by 1159pm
9	Tuesday, March 15, 2022	SPRING BREAK	
	Thursday, March 17, 2022		
10	Tuesday, March 22, 2022	STARCCM+ In Class Lectures	-
	Thursday, March 24, 2022	STARCCM+ In Class Lectures	SUBMIT ABSTRACT by 1159pm
11	Tuesday, March 29, 2022	Work on Project 2	No In-class meeting this week
	Thursday, March 31, 2022	Work on Project 2	4/1 - Spring Drop/Withdrawal Deadline

12	Tuesday, April 5, 2022	Work on Project 2	No In-class meeting this week
	Thursday, April 7, 2022	Work on Project 2	No In-class meeting this week
13	Tuesday, April 12, 2022	Work on Project 2	No In-class meeting this week
	Thursday, April 14, 2022	Work on Project 2	No In-class meeting this week
14	Tuesday, April 19, 2022	Work on Project 2	No In-class meeting this week
	Thursday, April 21, 2022	In Class Presentations See Presentation Schedule	Class Presentations for Design and Cost Estimation
	Tuesday, April 26, 2022	In Class Presentations See Presentation Schedule	Class Presentations for Design and Cost Estimation
15	Thursday, April 28, 2022	In Class Presentations See Presentation Schedule	Class Presentations for Design and Cost Estimation
	Tuesday, May 3, 2022	In Class Presentations See Presentation Schedule	Class Presentations for Design and Cost Estimation
16	Thursday, May 5, 2022	SUBMIT FINAL DESIGN BY MIDNIGHT	

MECH 4316 YouTube Videos Table of Contents

Topic	Video Title	Link
Introduction to ANSYS Fluent	Tutorial 1 Part 1	https://www.youtube.com/watch?v=v-jUz_TOcMo&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=46
Geometry Functions in ANSYS	Tutorial 1 Part 2	https://www.youtube.com/watch?v=4Ks44_4_SVU&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=47
2-D Geometry Development	Tutorial 1 Part 3	https://www.youtube.com/watch?v=9lOXFXs1Uhc&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=48
3-D Geometry Development	Tutorial 1 Part 4	https://www.youtube.com/watch?v=WwkYybm8PRA&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=49
Importing of Geometry from Third Party Software More Features of the ANSYS Geometry	Tutorial 1 Part 5	https://www.youtube.com/watch?v=t1bK4jV2uQ&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=50
Meshing Functions in ANSYS Development of Geometry and Meshing Example	Tutorial 2 Part 1	https://www.youtube.com/watch?v=VjnaWge5lO8&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=51
Size Refinement of Mesh 3D Meshing	Tutorial 2 Part 2	https://www.youtube.com/watch?v=0VpVTyc7qbQ&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=52
Inflation Layer Tutorial	Tutorial 2 Part 3	https://www.youtube.com/watch?v=CO_nOw46KX_w&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=53
Introduction to Fluent CASE and Model Setup	Tutorial 3 Part 1	https://www.youtube.com/watch?v=SM9Eh_gXGTc&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=54
Solution Options in Fluent	Tutorial 3 Part 2	https://www.youtube.com/watch?v=q4SaFdvNoMg&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=55

		x=55
Post Processing in Fluent and ANSYS	Tutorial 3 Part 3	https://www.youtube.com/watch?v=zW Mk5LEB4Zk&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=56
Laminar Flow Over a Heated Cylinder Problem Statement, Geometry, and Meshing	Tutorial 4 Part 1	https://www.youtube.com/watch?v=K mkz03CatIM&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=57
Laminar Flow Over a Heated Cylinder Import and Setup in Fluent	Tutorial 4 Part 2	https://www.youtube.com/watch?v=ZIn jMRUEOYU&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=59
Laminar Flow Over a Heated Cylinder Results	Tutorial 4 Part 3	https://www.youtube.com/watch?v=OC Fs5Q6mli4&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=60
Laminar Flow Over a Heated Cylinder Line Plots	Tutorial 4 Part 4	https://www.youtube.com/watch?v=dn 1KnysjMos&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=61
Laminar Flow Over a Heated Cylinder Comparison to Analytical Calculations	Tutorial 4 Part 5	https://www.youtube.com/watch?v=gm 1gqP89D70&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=62
Turbulent Flow Over a Heated Cylinder Problem Statement, Geometry, and Meshing	Tutorial 5 Part 1	https://www.youtube.com/watch?v=3g yl_Y4pta4&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=63
Turbulent Flow Over a Heated Cylinder Import and Setup in Fluent Results	Tutorial 5 Part 2	https://www.youtube.com/watch?v=_U OejsxCyWtM&list=PLr9AwDvt-4aBXZcWJAHPY3djTAxz9IlnH&index=64
2-D Laminar Flow Through a Pipe Problem Statement and Geometry	Tutorial 6 Part 1	http://youtu.be/Y89gTRIS_SQ
2-D Laminar Flow Through a Pipe Meshing, Import, and	Tutorial 6 Part 2	http://youtu.be/HxsMkiXUPaI

Setup in Fluent		
2-D Laminar Flow Through a Pipe Results and Post-Processing	Tutorial 6 Part 3	http://youtu.be/zrZXhr6XeSY
3-D Laminar Flow Through a Pipe Problem Statement, Geometry, and Meshing	Tutorial 6 Part 4	http://youtu.be/Q7cohWwQI6M
3-D Laminar Flow Through a Pipe Results and Post-Processing	Tutorial 6 Part 5	http://youtu.be/K-1YKU8F2x0
Transient Heat Transfer in a Mixing Channel Problem Statement and Geometry	Tutorial 7 Part 1	http://youtu.be/ZDoKlany0Kc
Transient Heat Transfer in a Mixing Channel Meshing and Fluent Setup	Tutorial 7 Part 2	http://youtu.be/EBZfob-8q_Y
Transient Heat Transfer in a Mixing Channel Results and Post-Processing	Tutorial 7 Part 3	http://youtu.be/YT56-O4bLlw
Transient Heat Transfer in a Mixing Channel Movie Animation	Tutorial 7 Part 4	http://youtu.be/epyBiVCq4RY
Co-Flow Heat Exchanger Problem Statement and Geometry	Tutorial 8 Part 1	http://youtu.be/pVx3-xaBDBU
Co-Flow Heat Exchanger Meshing	Tutorial 8 Part 2	http://youtu.be/aENSe6-DOO4
Co-Flow Heat Exchanger Fluent Setup	Tutorial 8 Part 3	http://youtu.be/h_rpnPs-0Nk

Co-Flow Heat Exchanger Results and Post-Processing	Tutorial 8 Part 4	http://youtu.be/VLdyi9NmOOo
Counter Flow Heat Exchanger Meshing, Fluent Setup, Results, and Post-Processing	Tutorial 8 Part 5	http://youtu.be/gC6DcuL5Gtw
BELOW <u>NOT</u> REQUIRED FOR COURSE		
Gaseous Methane Combustion Problem Statement and Geometry	Tutorial 9 Part 1	http://youtu.be/nUx0f6rODRg
Gaseous Methane Combustion Meshing	Tutorial 9 Part 2	http://youtu.be/5YRSuLanir8
Gaseous Methane Combustion Fluent Setup	Tutorial 9 Part 3	http://youtu.be/yUL3T_an4wI
Gaseous Methane Combustion Results	Tutorial 9 Part 4	http://youtu.be/AQLNE7kXplc
Water-Air Multiphase Flow Problem Statement and Geometry	Tutorial 10 Part 1	http://youtu.be/TS1t-THqWz8
Water-Air Multiphase Flow Meshing and Fluent Setup	Tutorial 10 Part 2	http://youtu.be/Tpk6kFdodmE
Water-Air Multiphase Flow Results, Post-Processing, and Movie Animation	Tutorial 10 Part 3	http://youtu.be/kW9YEZXbQQo