Department of Mechanical Engineering
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Uttyler.edu/engineering

# MENG 4348/5348 – Applied CFD and Heat Transfer
## Course Syllabus

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| **Semester / Year** | Fall 2024 |
| **Catalog Description** | This course provides an understanding of the theory and process of computational flow analysis and computational heat transfer analysis by giving students the opportunity to use commercial simulation software to design, model, and analyze thermo-fluid systems. |
| **Prerequisites** | **MENG 3401** (Thermodynamics)**, MENG 3316** (Heat Transfer) and **MENG 3310** (Fluid Mechanics) |
| **Section Number** | 050 and 051 |
| **Instructor Name** | Hayder Abdul-Razzak, PhD, PE |
| **Contact Information** | 832.439.7080; habdulrazzak@uttyler.edu |
| **Class Type / Instruction Mode / Location** | Hybrid mode<br>Tyler Room: RBN 03038<br>HEC Room: HEC 0C204 |
| **Class Time** | W 5:00PM – 7:45PM |
| **Office Hours** | M 1:30PM – 2:00PM, W 1:30PM – 4:00PM<br>Appointments may be scheduled in addition to regularly scheduled office hours. |
| **No. of Credits** | 3 |
| **Required Textbook** | N/A |
| **Optional References** | Short list of resources for learning ANSYS and practicing numerical analysis<br>1) ANSYS Student Community: This is a free resource offered by ANSYS. In addition to the discussion forums here, there are lots of helpful tutorials if you poke around a bit.<br>2) Textbooks recommended for Numerical Analysis: This is a list of books that someone over on ANSYS Student Community compiled of ANSYS specific books as well as general numerical analysis books.<br>3) Online courses: There are other courses offered in numerical analysis, including a Master's degree offered in ANSYS by a university in Madrid. Some of these will be free (such as MIT's Open Course Ware), whereas others might cost you something. Simply Google "numerical analysis course" and add "ANSYS" if you are only interested in ANSYS and not just general numerical analysis. |
| **Additional Rules and Requirements** | The course is designed to be used with the academic version of ANSYS located at one.uttyler.edu. A free ANSYS Student software (version 2019 R2), which can be downloaded at http://www.ansys.com/student. The software's model size will be |

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| | limited compared to the academic version. In downloading this software, you are agreeing to ANSYS' Terms of Use.<br><br>**You need a computer running Microsoft Windows (64-bit) to install ANSYS Student**. See ANSYS platform support for details. If you do not have access to a Windows computer, you have the option of to subscribe to one of ANSYS Cloud Hosting Partners that allow users the option of running ANSYS in a web browser on any device without the need to install it locally or installing a Microsoft operating system on your computer.<br><br>**Working laptops running Microsoft Windows (64-bit) operating system with at least 8 GB of RAM are required for use during class.**<br><br>Students who prefer to use a Mac will be required to also install a Microsoft Windows operating system or use a cloud-based service to use and access the software on their laptop. Please note that most of the software problems encountered in class come from students who are using a Mac with a Windows operating system. Contact IT support for assistance.<br><br>Working knowledge of a CAD software program is expected.<br><br>**Using AI tools.**<br>Students can use AI programs (ChatGPT, Copilot, etc.) in this course. If you utilize an AI tool to help create content for an assignment, you must acknowledge and cite the tool's contribution to your work. |
| **Evaluation Method** | Tutorials 30%/ Exercises 10%/ Project 30%/ Final Exam 30%<br>A = > 90, B = > 80, C = > 70, D = > 60, F < 60<br>F if scores 50% or Less on the Final Examination regardless of previous performance |
| **Grading Policy / Scale** | A = > 90, B = > 80, C = > 70, D = > 60, F < 60, F if 50% or less on the Final Exam |
| **Important Events / Dates** | Census date: Friday, September 9<br>Last Day to Withdraw date: Monday, November 4<br>Final Exam date: TBD |
| **Attendance / Makeup policy / other rules** | **ATTENDANCE.** Regular attendance is required. In case you have to miss a class, it is your responsibility to keep up with the class work and be informed of all announcements made in the class.<br><br>**THERE WILL BE NO MAKE-UP EXAMS.** The percentage of any exam missed by a student will be added to his/her final comprehensive exam only if prior approval is granted. The student is responsible to contact the instructor at least a week before the scheduled exam date to get an excuse from the exam. If you have to miss an exam due to emergencies (such as medical and other emergencies) please inform the instructor as soon as possible before or immediately after the exam. Class average for each exam will be announced in class and also posted in Canvas after each exam. Final course grades will be determined on the basis of the class average. If you miss any exam without getting **prior approval from the instructor at least a week before the exam** |

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| | **date**, it will be counted as zero in the calculation of your final course grade. If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least a week prior to the date of the planned absence. |
| **Course Learning Objectives / ABET & PEOs Relation** | By the end of this course students will be able to demonstrate the ability to:<br>1. use modern CFD software tools to build flow geometries, generate an adequate mesh for an accurate solution, select appropriate solvers to obtain a flow solution, and visualize the resulting flow field.<br>2. analyze a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses, and heat transfer, using flow visualization and analysis tools.<br>3. recognize the type of fluid flow that is occurring in a particular physical system and to use the appropriate model equations to investigate the flow.<br>4. simplify a real thermo-fluid system into a simplified model problem, to select the proper governing equations for the physics involved in the system, to solve for the flow, to investigate the fluid-flow behavior and heat transfer, and to understand the results.<br>5. communicate the results of this detailed fluid flow and/or heat transfer study in a written format.<br>6. Conduct a group major course project such as simulation design and analysis of a complete mechanical system using a CFD commercial software and report the results at a publishable level. |
| **Tentative Topics / Course Plans** | 1. Introduction to the use of modern CFD software, including geometry building, mesh generation, solution techniques, and flow visualization.<br>2. The investigation of various fluid flow and heat transfer systems aimed at a deeper understanding of the basic principles of fluid mechanics.<br>3. An assigned group major course project for undergraduates. A written project report is required.<br>4. An assigned individual major course project for graduates. A written project report is required. |
| **University Policies** | https://www.uttyler.edu/offices/academic-affairs/files/syllabus-information.pdf |

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| *Tentative Course Schedule* | | |
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| ***Week*** | ***Date(s)*** | ***Topics*** |
| 1 | 08/28 | Introduction to Computational Fluid Dynamics (CFD) |
| 2 | 09/04 | Physics and Mathematical Modeling |
| 3 | 09/11 | Finite Difference Method |
| 4 | 09/18 | Finite Element Analysis (FEA) |
| 5 | 09/25 | Finite Volume Method (FVM) |
| 6 | 10/02 | ANSYS Software |
| 7 | 10/09 | Modeling and Simulation – Internal Flows |
| 8 | 10/16 | Modeling and Simulation – External Flows |
| 9 | 10/23 | Modeling and Simulation – Turbulence |
| 10 | 10/30 | Modeling and Simulation – Heat Transfer |
| 11 | 11/06 | Modeling and Simulation – Transient Flow |
| 12 | 11/13 | Advanced Modeling and Simulation |
| 13 | 11/20 | Advanced Modeling and Simulation |
| 14 | 11/25 – 11/29 | Thanksgiving Break |
| 15 | 12/04 | Project |
| 16 | 12/09 – 12/13 | **Final Exam (Date TBD)** |