# ME 343 -Thermal-Fluid Systems – Spring 2018
# Course Syllabus for Unique #17370

**Instructor:** Yaguo Wang, ETC 7.150, yaguo.wang@austin.utexas.edu
Office Hours: Tuesday & Thursday 5~6pm, or by appointment

**Teaching Assistants:** TBD

**Class Meeting Times/Locations:**
Lecture: TTh, 3:30 p.m.-5:00 p.m, ETC 2.132
Discussion: Monday, 5:00-6:00pm, ETC 7.146

**Course Description:** ME 343 addresses the design and analysis of systems in which thermal and fluid processes are central to function and performance. New fundamental topics, such as thermodynamics of nonreacting and reacting gas mixtures, psychrometrics, heat exchanger design, turbomachinery theory and application, heat exchanger design, and pressure drop in thermal systems, will be covered in the context of specific thermal-fluid applications. Course prerequisites are ME 326 (Thermo), ME 330 (Fluid Mechanics) and ME 339 (Heat Transfer) and ME 218 (Engineering Computational Methods) with grades of C or better.

**Class Web Site on Canvas:** Supplemental readings and resources will be posted on the Canvas. Please check Canvas regularly for important announcements, homework assignments, and project updates and resources.

**Homework:** Homework will be posted on Canvas and will be due at the end of lectures according to the schedule on page 4 of this document. No paper copies will be distributed in class. **Late homework will not be accepted.**

**Projects:** 1. MATLAB Property Calculator Project. Team project.
2. Semester Project: A major computer-based analysis/design project which students will carry out in teams, and which will include a progress report and a comprehensive final report.

**Exams:** Two mid-term exams will be given during the semester. **There will be no final exam.**

**Grading:**

| | |
|---|---|
| Homework: | 20% |
| Exam 1: | 20% |
| Exam 2: | 20% |
| Matlab Property Calculator | 10% |
| Group Project Phase 1: | 10 % |
| Group Final Report: | 20% |
| | Total: 100% |

***The scores of your team projects will be adjusted based on the peer evaluation.

**Texts:** Text material will be the books used in ME 326, ME 330, and ME 339, plus additional handout notes provided by instructor. Helpful textbooks are:
1. Thermodynamics: An Integrated Learning System, by Schmidt, Ezekoye, Howell and Baker
2. Introduction to Fluid Mechanics, by Fox and McDonald
3. Fundamentals of Heat and Mass Transfer, by Incropera and DeWitt
4. Fundamentals of Engineering Thermodynamics, by Moran and Shapiro, 4th edition

**Observance of University policies:** Standard University policies relating to accommodation for students with disabilities and to scholastic dishonesty will be followed in this course. Information regarding these policies may be found in the General Information Bulletin.

**Expected incoming knowledge, skills and abilities:** Students having passed the course prerequisites listed above should have a sound base of theoretical knowledge in the fundamentals of thermodynamics, fluid mechanics and heat transfer and moderate skill in Excel and MATLAB programming. Writing skills appropriate to junior-level standing in engineering are assumed.

**Expected outgoing knowledge, skills and abilities:** Students successfully completing the course will have an enhanced level of theoretical and conceptual understanding of thermodynamics, fluid mechanics and heat transfer and a thorough understanding of how these disciplines apply to the design and analysis of complex thermal-fluid systems. They will have considerably enhanced skills in designing, programming and debugging software tools for systems analysis, working in teams, and preparing comprehensive professional-quality technical reports.

**Impact on subsequent courses in the curriculum:** Successful completion of ME343 will prepare students for further courses in engineering design, specifically ME366J and 466K, as well as such elective courses in Thermal-Fluid Systems as ME360N, ME369L, ME374C and 274D, and special projects electives in TFS.

**Design assignments:** Conceptual design analyses are performed for complex thermal-fluid systems. Typical projects, which vary from semester to semester, include industrial power systems, combined heat-power (CHP) cogeneration systems, aircraft propulsion systems, and thermal-fluid manufacturing systems.

**Laboratory assignments:** No laboratory assignments are assigned for the course except in special cases where testing of a piece of commercial hardware is involved in a given project.

**Computer assignments:** The course entails a substantial amount of programming of MATLAB for the personal computer to simulate performance of thermal/fluid systems. Specifics depend on the project being carried out.

**Professionalism Topics:** A major part of the class activity is carried out in teams typically composed of four students. In-class time is devoted to interpersonal relations in a professional environment, project planning, and associated issues of professional responsibility.

**Special Notes:** The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the College of Engineering Director of Students with Disabilities at 471-4321 to request an official letter outlining authorized accommodations. The letter should be handed over to Dr. Yaguo Wang no later than Feb. 13th, 2018.

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**ABET EC2000 PROGRAM OUTCOMES ACHIEVED:**

This course contributes to the following ME Program Outcomes**.** Priorities **(P)** assigned to each outcome are: 1=high priority (significant work devoted to this outcome), 2-moderate priority (some work devoted to this outcome), 3=low priority (little or no work devoted to this outcome)

| Outcome | P |
|---|---|
| **1.** Knowledge of and ability to apply engineering and science fundamentals to real problems. | 1 |
| **2.** Ability to formulate and solve open-ended problems. | 1 |
| **3.** Ability to design mechanical components, systems, and processes. | 1 |
| **4.** Ability to set up and conduct experiments, and to present the results in a professional manner. | 3 |
| **5.** Ability to use modern computer tools in mechanical engineering. | 1 |

| Outcome | P |
|---|---|
| **6.** Ability to communicate in written, oral and graphical forms. | 1 |
| **7.** Ability to work in teams and apply interpersonal skills in engineering contexts. | 1 |
| **8.** Ability and desire to lay a foundation for continued learning beyond the baccalaureate degree. | 2 |
| **9.** Awareness of professional issues in engineering practice, including ethical responsibility, safety, the creative enterprise, and loyalty and commitment to the profession. | 2 |
| **10.** Awareness of contemporary issues in engineering practice, including economic, social, political, and environmental issues and global impact. | 2 |

**ASME PROGRAM CRITERIA OUTCOMES ACHIEVED:**

| |
|---|
| a. Knowledge of chemistry and calculus-based physics with in-depth knowledge of at least one. |
| b. The ability to apply advanced mathematics through multivariate calculus and differential equations. |
| d. Ability to work professionally in both the thermal and mechanical systems areas including the design and realization of such systems. |

| **TOPICS:** | # of classes | Outcomes |
|---|---|---|
| Teamwork and project planning | 2 | 7 |
| Technical reporting standards and practices | 2 | 6 |
| Review of thermodynamic principles and properties | 4 | 1,2,3,5,a,b,d |
| Modeling and parametric analysis of thermodynamic cycles | 11 | 1,2,3,5,a,b,d |
| Gas mixtures and psychrometrics, with applications | 7 | 1,2,3,5,6,7,a,b,d |
| Chemically reacting mixtures and combustion | 5 | 1,2,3,5,6,7,a,b,d |
| Heat exchange systems analysis and design | 1 | 1,2,3,5,6,7,a,b,d |
| Fluid handling systems analysis and design | 1 | 1,2,3,5,6,7,a,b,d |
| Software design and development | 3 | 5 |

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# Course Schedule

| Week | Date | Topic | Reading | Assignment Due* |
|---|---|---|---|---|
| 1 | Jan. 16<br>18 | Introduction, Thermodynamics Review 1<br>Thermodynamics Review 2 | | |
| 2 | Jan. 23<br>25 | Thermodynamics Review 3<br>Thermodynamics Review 4 | | HW 1-1 due 1/25 |
| 3 | Jan. 30<br>Feb. 1 | Ideal Gas Mixtures 1<br>Ideal Gas Mixtures 2/ **Prop. Calc. Assgn** | | HW 1-2 due 2/1 |
| 4 | Feb. 6<br>8 | Ideal Gas Mixtures 3<br>Gas Powered Systems 1 | | HW 2 due 2/8 |
| 5 | Feb. 13<br>15 | Gas Powered Systems 2<br>Gas Powered Systems 3/ **Proj. Phase 1 Assgn.** | | **Prop. Calc. due 2/18 (Sunday)** |
| 6 | Feb. 20<br>22 | Gas Powered Systems 4<br>Vapor Powered Systems 1 | | HW 3 due 2/22 |
| 7 | Feb. 27<br>Mar. 1 | Vapor Powered Systems 2<br>Vapor Powered Systems 3 | | HW 4-1 due 3/3 |
| 8 | Mar. 6<br>8 | Vapor Powered Systems 4<br>**No Class** | **Exam I** | **HW 4-2 due 3/7 5:00pm**<br>**TBA** |
| 9 | Mar. 13<br>15 | **Spring Break**<br>**Spring Break** | **No Class**<br>**No Class** | |
| 10 | Mar. 20<br>22 | Combustion 1/ **Proj. Phase 2 Assgn.**<br>Combustion 2 | | **Project Phase 1 due 3/25 (Sunday)** |
| 11 | Mar. 27<br>29 | Combustion 3<br>Combustion 4 | | HW 5-1 due 3/29 |
| 12 | Apr. 3<br>5 | **Power Plant Tour**<br>Psychrometrics 1 | | HW 5-2 due 4/5 |
| 13 | Apr. 10<br>12 | Psychrometrics 2<br>Psychrometrics 3 | | Phase 2 Progress Report Due on 4/13 |
| 14 | Apr. 17<br>19 | Psychrometrics 4<br>Psychrometrics 5/Course Evaluation | | **HW 6 due 4/20 5:00pm** |
| 15 | Apr. 24<br>26 | **No Class**<br>Proj. Phas 2 Q&A | **Exam II** | **TBA**<br>Phase 2 Graphs Due 4/29 (**Sunday**) |
| 16 | May 1<br>4 | Proj. Phas 2 Q&A<br>**Final Report Due/Peer Evaluation Due** | | **Final Report due 5/4 5:00 pm** |

*Homework Problems will be posted on Canvas
*You can read the corresponding materials from any textbooks.