EGMN 303 – Thermal Systems Design

Course Description

This course starts with a review of fundamentals in three subjects: heat transfer, thermodynamics, and fluid mechanics, and progresses to advanced topics such as system modeling and optimization. Students will learn basic technical knowledge and analytic tools required for a thermal system design. The students will then apply the fundamentals to select, design, and analyze the applications of energy conversion systems. By the end of the course, the students should be able to:

- Work as a team to design, simulate, optimize, build, and test a thermal system by following an engineering design process.
- Apply the fundamentals of heat transfer, fluid mechanics, thermodynamics, economics, and optimization techniques towards the design and analysis of thermal systems.
- Use computer tools to solve thermal system models.

Topics covered in this class consists:

- Introduction on engineering design
- Economics on engineering design
- Basics in Thermodynamics
- Basics in Fluid dynamics (Pipe system, pumps, fans, etc.)
- Basics in Heat transfer (Heat transfer and heat exchanger)
- System modeling and optimization.

Details:

Prerequisite: EGMN 204 (Thermodynamics), EGMN 301 (Fluid Mechanics), and MATH 301 (Differential Equations), with a minimum grade of C in each, or permission of instructor.

Textbook: S. G. Penoncello (2018), "Thermal Energy Systems: Design and Analysis", 2nd ed, CRC Press

References: William S. Janna (2014), "Design of Fluid Thermal System," 4th ed, Cengage Learning.
Yogesh Jaluria (2007), "Design and Optimization of Thermal Systems," 2nd ed, CRC Press.

Instructor: Dr. Zeyun Wu (email: zwu@vcu.edu)

Schedule: 2:00 – 3:15 PM, Monday & Wednesday, Fall Semesters

Classroom: Room E2221, East Engineering Hall

Office hours: Upon email appointment

Attendance: Since class discussion is a major course ingredient, regular attendance is mandatory. Students with more than **4** unjustified absences will automatically receive an **F** in the course. Justified absence requires an in-writing notification with proving documentations.

Class manner: This is special for the online lecturing only. Students must be muted during the lecture time. Unless class discussion is invoked, students cannot speak individually. However, if you have questions, you can raise up your hands through the 'hand-raise' button in the Zoom chat dialogue. You can also ask questions directly through the Zoom chat dialogue, but please do not make class irrelevant chatting in the chat dialogue. It is acceptable that

Homework: Homework sets will be assigned at least one week in advance and will be due at the end of the due date except otherwise noted. All homework need to be submitted electronically through Canvas. **No credit will be given if homework is received after the due time.** However, the due time may be extended at certain circumstances. You are encouraged to work in small groups but you must hand in your own work to receive credit. The homework will be graded on the method of the problems as well as the answers.

Project: The project assignment will be stated in a separate form.

Exam: There will be three mid-exams and one final exam. All exams will be take-home ones. You will have at least 24 hours to finish the exam problems. You cannot discuss with anybody else for the exam and have to work on the problems independently. However, if you have questions on the exam sheet, you can contact the instructor through the emails. All exams will be turned in electronically through Canvas. **No credit will be given if the exam solution is received after the due time.** However, the due time may be extended at certain circumstances.

Grade:

Homework and Attendance	30%,
Project	20%,
Mid-Exam I (~75 minutes)	10%,
Mid-Exam II (~75 minutes)	10%,
Mid-Exam III (~75 minutes)	10%,
Final Exam	20%.

Final grade: **A**=90-100: **B**=80-89; **C**=65-79; **D**=55-64: **F**<55

Others: This syllabus is subject to change. Please visit **Canvas** to get the latest updates to the syllabus and other class information. Materials provided in class and in **Canvas** are for your personal use only. So please do not distribute them to others or any public domain.

Important note: students should visit http://go.vcu.edu/syllabus and review all syllabus statement information. The full university syllabus statement includes information on safety, registration, the VCU Honor Code, student conduct, withdrawal and more.

Course Contents and Schedule (subject to change)

Class	Day	Date	Topics	HW and Due date	Textbook Reading
1	Wednesday	8/25/202x	Introduction (1/2)		1.4, 1.5, 1.6
2	Monday	8/30/202x	Introduction (2/2)		
3	Wednesday	9/01/202x	Economics (1/2)		2.3 to 2.7, 2.8.2, 2.9
	Monday	9/06/202x	No class (Labor Day)		
4	Wednesday	9/08/202x	Economics (2/2)	#1, 9/15/2x	
5	Monday	9/13/202x	Basics in thermodynamics (1/3)		1.5, 3.4 - 3.9
6	Wednesday	9/15/202x	Basics in thermodynamics (2/3)	#2, 9/29/2x	
7	Monday	9/20/202x	Basics in thermodynamics (3/3)		
8	Wednesday	9/22/202x	**Mid-Exam 1**		
9	Monday	9/27/202x	Basics in fluid dynamics (1/7)		4.2, 4.3, 4.4, 4.5(exclude 4.5.1), 4.7
10	Wednesday	9/29/202x	Basics in fluid dynamics (2/7)	#3, 10/13/2x	
11	Monday	10/04/201x	Basics in fluid dynamics (3/7)		
12	Wednesday	10/06/202x	Basics in fluid dynamics (4/7)	#4, 10/13/2x	
13	Monday	10/11/202x	Basics in fluid dynamics (5/7)		
14	Wednesday	10/13/202x	Basics in fluid dynamics (6/7)	#5, 10/27/2x	
15	Monday	10/18/202x	Basics in fluid dynamics (7/7)		
16	Wednesday	10/20/202x	**Mid-Exam 2**		
17	Monday	10/25/202x	Basics in heat transfer (1/3)		5.2, 5.3, 5.4
18	Wednesday	10/27/202x	Basics in heat transfer (2/3)	#6, 11/03/2x	
19	Monday	11/01/202x	Basics in heat transfer (3/3)		
20	Wednesday	11/03/202x	Heat exchanger general (1/3)	#7, 11/10/2x	5.5, 5.6
21	Monday	11/08/202x	Heat exchanger general (2/3)		
22	Wednesday	11/10/202x	Heat exchanger specific (1/4)		5.7, 5.8, 5.9, 5.10, 5.11
23	Monday	11/15/202x	Heat exchanger specific (2/4)	#8, 11/29/2x	
24	Wednesday	11/17/202x	Heat exchanger specific (3/4)		
	Monday	11/22/202x	No class (Fall Break)		
	Wednesday	11/24/202x	No class (Fall Break)		
25	Monday	11/29/202x	Heat exchanger specific (4/4)		
26	Wednesday	12/01/202x	**Mid-Exam 3**		
27	Monday	12/06/202x	System simulation	#9,12/13/2x	Chapter 6
28	Wednesday	12/08/202x	System optimization		
29	Monday	12/13/202x	Comprehensive Review	Last class	
	Monday	12/20/202x	**Final Exam (12:30 – 3:20 PM)**		