**Syllabus Spring 2020**

# ENME 635 Energy Systems Analysis

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**Lecture**: Tuesday..... 4:00 pm- 6:40pm, JMP 2222

## Course Description

Sustainable energy utilization demands the analysis of current and future energy conversion systems. The course will teach and discuss the design and analysis of conventional and novel energy conversion systems, energy system integration and annual energy consumption estimation methods. Students will carry out design projects for modeling such energy conversion cycles and analyzing their performance potential using conventional, renewable energy and/or waste heat from various processes.

## Reference (recommended books, not mandatory):

- Any Energy Conversion Textbooks
- Hwang, Radermacher, Vapor Compression Systems with Refrigerant Mixtures, Taylor and Francis, Boca Raton, FL, 2005. ISBN 9780849334894
- Alefeld, Radermacher, Heat Conversion Systems, CRC Press, ISBN 9780849389283, Boca Raton, FL, 1994
- Herold, Radermacher, Klein, 2nd Edition, Absorption Heat Pumps and Chillers, ISBN-13: 978-1498714341, Boca Raton, FL, 2016

**Prerequisites by Topic:** Thermodynamics, Transfer Processes

## Topics:

1. Introduction Energy Terms and Balances and What They Mean
2. Rankine Power Cycles, Conventional and Transcritical Versions, Combined Cycle Power Plants
3. Introduction to Heat Conversion
4. Moist Air Properties and Processes
5. Properties of Working Fluids
6. Energy Conversion Systems
   a. Vapor Compression Cycles with Mixtures
   b. Transcritical Power and Cooling Cycles
   c. Absorption Cycles
   d. Desiccants
   e. Adsorption Systems
   f. Power Generation
   g. Unconventional Cycles
7. Annual Performance Evaluation
8. Integrated Systems (CHP and others)

9. Economic Considerations

**Learning Outcomes:**

Areas of Knowledge and Capabilities: There are three key items students are expected to have a solid understanding of after completion of the class: the analysis, design and functioning of energy conversion cycles as they pertain for building, campus and industrial applications, of moist air processes for air-handling and the implications of load curves of overall system integration challenges. Particular emphasis is placed on the integration of the concept of cogeneration in various aspects.

Tools: Students are expected to become familiar with software (Engineering Equation Solver, Spreadsheets), deepen the application of thermodynamic laws and diagrams (psychometric charts, pressure-enthalpy diagrams, enthalpy-mass fraction diagrams, temperature-entropy diagrams).

**Course Outcomes**:
Students are expected to learn through this course the application of thermodynamics and transfer processes as studied in the prerequisite classes to all commonly used energy conversion systems with an extension of the knowledge and experience to emerging energy conversion technologies and approches. This course is a technical design elective and pulls together the background knowledge in real life examples of design and evaluation.

**Professional Outcome:**
Successful completion of this course will equip students with the terminology, knowledge and some practice necessary to obtain employment with a great head start in the field of HVAC, energy conversion and Cooling, Heating and Power (CHP) systems, coupled with the ability to quickly and competently assess any emerging energy conversion technology.

**Grading:**
About six to eight projects will be assigned. At this time students will work on projects in small groups. Students will be asked to make in-class presentations of their project results for discussion. Projects will make up 100% of the final grade. Group Project grades will possibly be weighted based on a peer-evaluation at the end of the class. For an “A” grade a student is expected to achieve 90% and above, for “B” 80% - 89.9%.

**Code of Academic Integrity:**
"The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html."