AMES 5410 Introduction to Energy Management in Manufacturing

Course description: This course is aimed at introducing foundational concepts and methods of energy management in manufacturing. The motivation of energy efficient manufacturing and energy management in manufacturing is first introduced. Systematic methods for energy consumption modeling and analysis in manufacturing enterprises as well as in manufacturing facilities, including lighting, motors and drives, compressed air, process heating/cooling, HVAC, etc., will be presented. Identification of energy sinks and energy saving/harvesting opportunities in manufacturing will be discussed. Basic introduction of whole building energy simulation program EnergyPlus™ will be given in the course. The course will also discuss ISO 50001 standards on energy management.

Credits: 3

Pre-requisites: Graduate standing

Course objective: In recent years, improving energy efficiency has become one of the most important goals of modern manufacturing enterprises. The goal of this course is to present the theory and methods of energy modeling, analysis, assessment, and management in manufacturing. The course will cover major energy consumption areas in manufacturing facilities, including lighting, motors and drives, compressed air, process heating/cooling, HVAC, etc. Topics in this course include: Energy conservation, irreversibility concepts, and renewable energy sources for energy systems analysis; process analysis of heating, cooling, and power generation; compressors, pumps, and energy loss analysis in fluid flow transportation; heat and mass transfer for ovens, boilers; manufacturing process energy efficiency analysis; energy performance and energy efficiency savings for manufacturing processes; energy sink identification and energy harvesting.

After completing the course, the students are expected to obtain:

- Understanding energy consumption and energy efficiency in typical manufacturing processes.
- The ability to apply physics and/or engineering principles to model and analyze various energy sources in typical manufacturing processes.
- The ability to design the energy assessment project for typical manufacturing facilities.
- The ability to identify energy sinks, and design continuous improvement projects to improve/optimize the energy efficiency in manufacturing processes.
- The ability to quantify energy saving based of the improvement recommendation.
- The ability to build basic building energy simulation models using EnergyPlus™.
- Basic knowledge to prepare for ISO 50001 certification.

Required textbook: Class handouts and lecture notes

Other references:

- *Guide to Energy Management*, 7th Edition, Barney L. Capehart, Wayne C. Turner, and William J. Kennedy ISBN: 0-88173-671-6, The Fairmont Press, Inc., 2016
- *Energy Efficient Manufacturing: Theory and Applications*, John W. Sutherland, David A. Dornfeld, Barbara S. Linke, Wiley, 2018

- *Simple Solutions to Energy Calculations,* 5th Edition, Richard R. Vaillencourt, The Fairmont Press, Inc., 2013

Computer software: Whole building energy simulation program EnergyPlus™ will be introduced during the lectures and included in homework assignment problems. The software can be downloaded from https://energyplus.net/.

Homework: Bi-weekly homework sets will be assigned and are due in class in two weeks. Homework should be performed individually, however constructive discussions with classmates are allowed. Late submissions are accepted but will be penalized with a reduced grade of 20% for each day. The lowest HW will be dropped from the final grade calculation.

Exams: The course includes two midterm exams. The exams are closed-book, closed-notes. A one-sided 8.5-by-11 "cheat" sheet is allowed for the in-class exam and two-sided for Final Exam. The sheets can only contain formulas, equations, theorems, and conclusions from the Textbook. Including answers and solutions to specific problems, such as textbook examples, homework and exam problems, on the sheets are strictly prohibited. The sheets must be handwritten, and turned in with the exam papers. Violations of the above rules will lead to serious penalty (up to 100%) on the exam scores. The exams will be graded out of 100 points.

Project: The course includes a project to be carried out by teams of 3-4 students. The project will be graded out of 100 points and will be evaluated on each of the components involved (i.e., the results obtained, quality of the project report, and of the final presentation). Project presentations will be arranged at the last one or two sessions. Details instructions about the project will be posted in a separate document and uploaded on HuskyCT.

Academic integrity: All forms of academic misconduct are prohibited. The Undergraduate Academic Integrity policy regarding academic misconduct states, "Academic misconduct is dishonest or unethical academic behavior that includes, but is not limited, to misrepresenting mastery in an academic area (e.g., cheating), failing to properly credit information, research or ideas to their rightful originators or representing such information, research or ideas as your own (e.g., plagiarism)".

Course Website: All course material (syllabus, supplemental materials, homework assignments, etc.) will be uploaded on HuskyCT.

Course Grading:

Homework	30%
Exam 1	25%
Exam 2	25%
Project	20%

Grade Scale							
A+	= 97 – 100%						
A	= 93 – 96.99%	**B**	= 83 – 86.99%	**C**	= 73 – 76.99%	**D**	= 63 – 66.99%
A-	= 90 – 92.99%	**B-**	= 80 – 82.99%	**C-**	= 70 – 72.99%	**D-**	= 60 – 62.99%
B+	= 87 – 89.99%	**C+**	= 77 – 79.99%	**D+**	= 67 – 69.99%	**F**	= 0 – 59.99%

Special accommodations: Please contact me during office hours or by appointment to discuss academic accommodations that may be needed during the semester due to a documented disability. The Center for Students with Disabilities (CSD) engages in an interactive process with each student and reviews requests for accommodations on an individualized, case-by-case basis. Depending on the nature and functional limitations of a student's documented disability, he/she may be eligible for academic accommodations. CSD collaborates with students and their faculty to coordinate approved accommodations and services for qualified students with disabilities. If you have a documented disability for which you wish to request academic accommodations and have not contacted the CSD, please do so as soon as possible. The CSD is located in Wilbur Cross, Rm 204 and can be reached at 860-486-2020 or at csd@uconn.edu. Detailed information regarding the process to request accommodations is available on the CSD website at www.csd.uconn.edu.