AMES 5461 Production Systems Engineering for Energy Efficient Manufacturing

Instructor: Liang Zhang

Course description: Production Systems Engineering (PSE) is a branch of Engineering intended to uncover fundamental laws that govern manufacturing systems (e.g., serial production lines and assembly systems) and exploit them for the purposes of analysis, design, and management. In this course, fundamental principles in PSE will be described along with numerous case studies in large volume industries (such as automotive, electronics, consumer productions, etc.) The material presented is based on first principles rather than on recipes. In addition to traditional focus on system productivity and quality, the course will also discuss how to apply the PSE theory in analysis and control of manufacturing systems for energy efficient production. The course will also teach computer software tools, such as the PSE Toolbox and Simul8 to facilitate the application of the theoretical material.

Credits: 3

Pre-requisites: Graduate standing

Course objective: The course is intended for senior undergraduate and graduate students from all engineering disciplines who are planning a career with any relation to manufacturing, e.g., production systems design and/or control, product/process design, , semiconductor manufacturing, production automation and control, planning and scheduling, etc.

Specific topics include:

1. Mathematical modeling of production systems
2. Performance analysis
3. Bottleneck identification and continuous improvement
4. Lean buffering design
5. Lead time control
6. Transient analysis and preventive maintenance for energy efficient production
7. Real time control of production lines for energy efficient production

These topics are addressed in the framework of stochastic models of serial lines and assembly systems. Upon completion of the course, the students are expected to be able to: 1) Understand the fundamental principles of continuous improvement, bottleneck identification, design and control in PSE; 2) Construct and simplify structural models of real manufacturing systems; 3) Use PSE Toolbox and Simul8 software to evaluate performances and suggest improvement projects for productivity, quality, and/or energy efficiency improvement.

Required textbook: Class handouts and lecture notes

Other references:

- *Production Systems Engineering*, Jingshan Li and Semyon M. Meerkov, Springer, 2009
- *Sustainable Production Automation*, Andrea Matta, Stephan Biller, Ying Tang, Bengt Lennartson, Jingshan Li, *ed.*, Momentum Press, 2017
- *Energy Efficiency in Manufacturing Systems*, Springer, 2012

Computer software: The class will introduce and teach two software packages: 1) *PSE Toolbox*, i.e., a suite of computer programs, which implements techniques and algorithms of PSE; 2) *Simul8*, a professional simulation software package commonly used in manufacturing studies.

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 one in-class midterm exam and one take-home midterm exam. The in-class exam is closed-book, closed-notes. A one-sided 8.5-by-11 "cheat" sheet is allowed for the in-class exam. The sheet can only contain formulas, equations, theorems, and conclusions from the lecture notes or references. Including answers and solutions to specific problems, such as 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%
In-class exam	25%
Take-home exam	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.