**SYLLABUS**

**IEE 561 Production Systems**

**Spring 2013, TTH 10:30-11:45am, BYAC 220**

**INSTRUCTOR:**

Ronald G. Askin, BY548, ron.askin@asu.edu

Office Hours: 8:30-10:00am TTH or by appointment

Teaching Assistant: Aysegul Demirtas, ademirt2@asu.edu

**Catalog Description**: Understanding how factories operate, how performance is measured, and how operational changes impact performance metrics. Operational philosophies, increasing production efficiency through quantitative methods.

**TEXT BOOK:**

Askin, R. & C. Standridge, *Modeling and Analysis of Manufacturing Systems*, J. Wiley & Sons, 1993.

**REFERENCES**:

Spearman, M. and W. Hopp, *Factory Physics*, McGraw Hill, 2000.

Gershwin, S., *Manufacturing Systems Engineering*, Prentice-Hall, 1994.

Yao, D. (ed.), *Stochastic Modeling & Analysis of Mfg. Systems*, Springer, 1994.

Buzacott, & Shanthikumar, *Stochastic Models of Mfg. Systems*, Prentice-Hall, 1993.

Askin & Goldberg, *Design and Analysis of Lean Production Systems*, John Wiley, 2002.

**COURSE OBJECTIVES:**

The intent of this course is to develop competence in developing and applying quantitative models to improve the design and operation of modern manufacturing systems. The course focuses on the flow of jobs through a production facility as materials are transformed into products. Emphasis is placed on analytical models for guiding how resources (humans, machines, tools and information) should be utilized to facilitate this flow. Upon completion of this course the student should be familiar with the components of modern manufacturing systems and their interactions. The student should be able to apply appropriate quantitative analysis techniques to design and operate such systems. Stochastic and deterministic techniques will be discussed. Optimal and heuristic algorithms will be covered.

**Prerequisites by Topic:**

1. Probabilistic Modeling (IEE 380/470)

2. Deterministic Optimization (IEE 376)

3. Basic familiarity with manufacturing processes and systems is desirable.

**Specific Instructional Goals:**

1. Understanding of the basic physical and social laws that affect mfg. system performance.

2. Ability to design an assembly system for one or more products.

3. Ability to evaluate and exploit value of manufacturing flexibility.

4. Understanding of the impact of WIP level and buffer capacity on system performance.

5. Understanding of the basics of push and pull production control.

6. Ability to design and evaluate mfg. layouts and material handling systems.

7. Ability to apply stochastic models to analyze a proposed open or closed mfg. system.

8. Understanding of the impact of variability on production rate and cycle time.

9. Ability to develop an appropriate model and solution algorithm for mfg. system design or

operational control.

10. Understanding of the key principles of warehouse management.

**Grading:**

Case Study 15%

Paper 10%

Exams I & II 40%

Final Exam 35%

**Case Study:**

Students will work in groups of three or four to design and analyze a manufacturing system. System requirements will be provided. The project may require equipment selection, layout, specification of the operating rules and a cost analysis. The final report should begin with a one page Executive Summary describing the problem, solution approaches, and conclusions. Detailed calculations supporting the statements in the descriptive body of the report should be cited in the text and attached as Appendices. Presentation, including neatness, grammar, and coherency will be considered as well as completeness and accuracy in grading the project. It is expected that the project report will include the results of computational models that validate the effectiveness of the system design.

**Paper:**

Each student will select a specific topic relevant to this course, read at least two journal articles on this topic and write a **two page** report. Page one should begin with a project title and then present a summary of each paper stating problem scope, key assumptions, methods used, and major results. Page two should be a discussion containing a critical analysis that compares the papers, comments on the appropriateness of the models, and the significance of the results. This would ideally include a succinct “proposal” of what could be done as a research project to expand upon the results in the papers and produce new knowledge. Think of this as a brief Master’s thesis proposal. The report should end with a list of references (the papers read) in proper bibliographical format. **Project topics and the list of papers to be read must be submitted by March 18, 2013.** Unless otherwise approved, articles should be selected from the following journals:*IIE Transactions, Interfaces, International Journal of Production Research, European Journal of Operational Research, Management Science, Operations Research, Manufacturing & Service Operations Management, International Journal of Production Economics, Queueing Systems.*  At least one paper must be less than five years old (2008 or later). Reports are due at the last regularly scheduled class. Note that all content must be your own original work. Attribute any borrowed ideas or text appropriately. Make sure you understand the difference between original work and plagiarism! Papers will be checked with SafeAssign.

Possible topics include, but are not limited to:

* Generalized or extended kanban systems
* The value of cross-training in manufacturing systems
* Design of cellular manufacturing systems
* Stochastic models of cyclic queues
* Throughput approximations for mulitstage transfer lines
* Scheduling of semiconductor wafer fabs
* Stochastic modeling of fork (disassembly) and join (assembly) stations in networks
* Optimal allocation of processor capacity or buffer capacity in serial or general networks
* Warehouse layout design for throughput maximization
* Order picking strategies
* Design of automated material handling systems
* Shop floor information control systems
* Hierarchical scheduling of flexible manufacturing sytems
* Operational performance measures for GI/G/c queues

**Class Rules:**

1. Homework problems will be assigned. Homeworks will not be graded but may be collected to ensure completion and gauge level of understanding. Students may discuss homework problems and solution methods but should work problems independently to ensure understanding.
2. Makeup exams will not be given. Students unable to take an exam must have an authorized excuse and receive prior permission from the instructor. The final exam grade will replace the missed exam score.
3. Students are responsible for all material presented in class and in the reading assignments indicated on the syllabus. All material listed in the reading assignments, included in homework assignments or discussed in class is fair game for the exams.
4. Academic Integrity and Code of Conduct. The ASU Student Academic Integrity Policy <https://provost.asu.edu/academicintegrity/policy> will be strictly enforced. **All students are responsible for understanding and following the policy**. Violations will be reported to the Dean’s office. Possible penalties include reduced or no credit for submitted work, failing grade in the class (XE), removal from the degree program, suspension or expulsion from the university, or revocation of a degree. All work submitted must be the original work of the student and any sources used must be clearly cited and included in the list of references. Plagiarism, including use of print or web materials or self-authored material previously submitted for credit in another course, without proper citation and disclosure is strictly forbidden.
5. Students are expected to attend the lectures and arrive on time. Students should inform the instructor if for some reason they will be late, leave early or not be able to attend.
6. The instructor reserves the right to modify the syllabus during the semester. Changes will be announced in class.

Tentative (Slightly Optimistic) Syllabus

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| Class Date | Topic | Reading |
| 1/8 | Introduction/Review |  |
| 1/10 | Principles and Types of Mfg. Systems | Ch. 1 |
| 1/15 | Assembly Line Balancing – Defn. & RPW | Ch. 2 |
| 1/17 | Assembly Line Balancing - Optimization |  |
| 1/22 | Mixed Model Sequencing |  |
| 1/24 | Random Serial Systems (Transfer Lines) - Without Buffers | Ch. 3 |
| 1/29 | - With Buffers |  |
| 1/31 | - Buffer Allocation |  |
| 2/5 | Allocation of Work in Multistage Parallel Systems | notes |
| 2/7 | Lean Manufacturing Concepts and Scheduling Principles | Ch. 4 |
| 2/12 | JIT Kanban and Generalized Kanban Systems | notes |
| 2/14 | MRP Control Systems | notes |
| 2/19 | Impact of Variability |  |
| 2/21 | EXAM I |  |
| 2/26 | Flexible Manufacturing Systems - Loading | Ch. 5 |
| 2/28 | Group Technology - Coding Systems | Ch. 6 |
| 3/5 | - Cell Formation | “ |
| 3/7 | Single Stage Poisson Queues | Ch 11 |
| 3/12 | Spring Break |  |
| 3/14 | Spring Break |  |
| 3/19 | Busy Periods; Priority Service | “ |
| 3/21 | Non-Poisson Queues | “ |
| 3/26 | Jackson Networks | “ |
| 3/28 | Open Model Extensions - General Service Time | “ |
| 4/2 | Closed Queueing Networks – Definition and Mean Value Analysis | “ |
| 4/4 | - Model Extensions and Generalizations | “ |
| 4/9 | EXAM II |  |
| 4/11 | Facility Layout Algorithms – QAP, Planar Graphs, LP | Ch. 7 |
| 4/16 | Operational Assignment/Sequencing Problems | Ch. 8 |
| 4/18 | Material Handling Design and Routing | Ch. 9 |
| 4/23 | Warehouse Design | Ch 10 |
| 4/25 | Warehouse Management (Storage allocation) | “ |
| 4/30 | Review |  |

**Final Exam: Tuesday May 7th, 9:50-11:40am. Open Book, Open Notes**