ISyE 6201 Manufacturing Systems
Spring 2026
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Course Meeting Times: TuTh 12:30pm-1:45pm
Course Classroom: Klaus Advanced Computing 2447
Instructor Office Hours: TuTh 10:00-11:30am or by appointment
Course TA: Sai Sravya Kuraparthi
TA Office Hours: TBA

Course Objective

This course is an introduction to the concepts and problems underlying the design and operation of contemporary production systems. Emphasis is placed on the design and operation of manufacturing facilities, but many of the presented results apply also to the design, planning and control of operations taking place in the service sector.

More specifically, the course seeks to offer a balanced development of the following issues:

- A systematic exposition of the design, planning and control problems that arise in the context of the aforementioned facilities.
- A systematic introduction to inventory control theory and its application in the contemporary production and distribution networks.
- A formal analysis of the dynamics of production processes, based on queueing theoretic concepts and models.
- The integration of the results developed in Step 3 to the prevailing production planning and control framework(s).

Tentative Course Outline

1. Introduction: Course Objectives, Context, and Outline
   - Contemporary organizations and the role of Operations Management (OM)
   - The basic organizational structure and the scope of the OM issues addressed in this course
   - Corporate strategy and its connection to operations
   - The basic course structure
2. Inventory Control Theory
   - The basic EOQ model and some of its variants
   - Replenishment coordinating approaches
   - Dynamic Lot Sizing
   - Statistical Inventory Control Models
     - The News Vendor Model
     - The Base Stock Model
     - The (Q,r) Model
3. Factory Physics: A queueing-theoretic analysis of serial production systems
   - High-volume discrete-part manufacturing, overview of manufacturing layouts, and transfer (or flow) lines as the preferred layout for discrete-part, repetitive manufacturing
   - Flow line classification: Synchronous vs. Asynchronous production lines, Push vs. Pull, KANBAN and CONWIP-based production systems
   - Modeling and analyzing a flow line as a queueing system

- Understanding the fundamental relationships between the line attributes and its performance indices
- Analyzing the impact of the various operational detractors and the resulting operational variability

4. Design of synchronous transfer lines – the problem of Assembly Line Balanacing
5. Production Planning
   - The Hierarchical Planning framework
   - Aggregate Planning
   - Master Production Scheduling (MPS) and Material Requirement Planning (MRP)
   - Shop floor scheduling
   - The notions and the significance of Just-in-Time (JIT) and Lean Manufacturing

Course Prerequisites: ISYE 6650 (Probabilistic Models) and ISYE 6669 (Deterministic Optimization).

Among the above prerequisites, ISYE 6650 is the most important. In particular, students are expected to have some exposure to stochastic modeling and introductory queueing theory. Please, contact me if you need further discussion on this issue.

Course Policies

Homework: Homework will be assigned upon the completion of each course unit, and it will consist of conceptual, theoretical and computationally oriented problems. Collaboration towards its solution is allowed, but each student must turn in his/her own work; photocopies will *not* be accepted. Homework must be turned in on the specified due date.

Project: Two projects that will be based on the well-known game of Littlefield technologies will be carried out at certain stages of the course. These projects aim to provide a more integrating perspective for the material covered in class, and to expose the student to some of the intricacies of the "real-world".

Exams: There will be a midterm and a final exam. The midterm exam will take place upon the completion of the two major parts of the course listed above, and the final exam will focus on the remaining three parts. The exact date of the midterm exam will be specified during the course development.

It is expected that the *Academic Honor Code* will be respected.

Grading:

- Homework: 15%
- Projects based on Littlefield Technologies Simulation Platform: 10%
- Midterm: 35%
- Final: 40%

Course Reading Material

- **Textbook:** W. Hopp and M. Spearman, *Factory Physics, 3rd ed.,* IRWIN / McGraw-Hill, 2008

- Course slides and any other material posted at my homepage and/or the library electronic reserves.

Notice that the textbook will have a complementary role to the material presented in class.

Other useful references:

1. Any other introductory book on Operations Management; e.g.,
   - Jay Heizer and Barry Render, *Operations Management*, 6th ed., Prentice Hall
   - R. Russel and B. Taylor, III, *Operations Management*, 3rd ed., Prentice Hall
   - Bedworth and Bailey*, Integrated Production Control Systems: Management, Analysis and Design*, John Wiley.
   - S. Nahmias, *Production and Operations Analysis, 5th ed.,* McGraw Hill.
2. Bill Scott, *Manufacturing Planning Systems*, McGraw Hill: A more practical but nicely structured perspective on MRP-based production planning and control.
3. A.C. Hax and D. Candea, *Production and Inventory Management*, Prentice Hall: A classical reference for the Hierarchical Production Planning and Control framework.
4. R. G. Askins and Jeffrey B. Goldberg, *Design and Analysis of Lean Production Systems*, John Wiley & Sons: Another formal treatment of the production planning and control problem, with considerable emphasis on modern trends.
5. G. Cachon and C. Terwiesch, *Matching Supply with Demand*, McGraw Hill: A business-school version of the prevailing theory on (production) process design and analysis.
6. J. Buzacott and G. Shantikumar, *Stochastic Models of Manufacturing Systems,* Prentice Hall: A rigorous treatement of the queueing-theoretic modeling and analysis of many manufacturing systems layouts encountered in contemporary practice.
7. S. Gershwin, *Manufacturing System Engineering*, Prentice Hall: The production planning and control problem addressed as a stochastic optimal control problem.
8. E. Silver, D. Pyke and R. Peterson, *Inventory Management and Production Planning and Scheduling,*Wiley: Maybe the most standard textbook on Inventory Control theory.
9. G. L. Curry and R. M. Feldman, *Manufacturing Systems Modeling and Analysis (2nd ed.),* Springer: Inspired by Factory Physics but providing a more comprehensive and in-depth treatment.
10. Journals and Magazines:
    - IIE Solutions
    - Interfaces
    - International Journal of Production Research
    - Journal of Production and Operations Management
    - Journal of Manufacturing Systems
    - International Journal of Flexible Manufacturing Systems
    - IIE Transactions
    - Operations Research
    - Management Science