APPLICATION FOR NEW COURSE

1. Submitted by College of Engineering Date November 13, 2001
Department/Division offering course Manufacturing Systems Engineering

2. Proposed designation and Bulletin description of this course
   a. Prefix and Number MFS 612
   b. Title* Design of Lean Manufacturing Systems
      *NOTE: If the title is longer than 24 characters (including spaces), write
      A sensible title (not exceeding 24 characters) for use on transcripts
   c. Lecture/Discussion hours per week 3
   d. Laboratory hours per week
   e. Studio hours per week
   f. Credits
   g. Course description Technical design of manufacturing systems in accordance with lean
      manufacturing principles. Topics include models for characterization and analysis
      of factory flow dynamics, production flow analysis, work cell design, and design
      of pull-based production control systems.
   h. Prerequisites (if any)
      MFS 503 Lean Manufacturing Principles and Practices
   i. May be repeated to a maximum of (if applicable)

3. To be cross-listed as

4. Effective Date (semester and year)

5. Course to be offered
   ☑ Fall ☑ Spring ☐ Summer

6. Will the course be offered each year?
   ☐ Yes ☑ No
   (Explain if not annually)
   Not a required course for the MFS program. Will be offered approximate once every
   third semester depending upon demand.

7. Why is this course needed?
   Lean manufacturing is an area of strong interest in Manufacturing Systems Engineering
   This course is necessary for students to build a complete understanding of the technical
   components of lean manufacturing. It complements a major programmatic thrust at CRMS.

8. By whom will the course be taught?

9. Are facilities for teaching the course now available?
   ☑ Yes ☐ No
   If not, what plans have been made for providing them?

ORIGINAL
10. What enrollment may be reasonably anticipated? 10-15

11. Will this course serve students in the Department primarily?  
   □ Yes  ✔ No

Will it be of service to a significant number of students outside the Department?  
   ✔ Yes  □ No

Graduate students with manufacturing interest in the ME program would find this course of value and have taken pilot versions of the course.

Will the course serve as a University Studies Program course?  
   □ Yes  ✔ No

If yes, under what Area?

12. Check the category most applicable to this course  
   □ traditional; offered in corresponding departments elsewhere;  
   □ relatively new, now being widely established  
   ✔ not yet to be found in many (or any) other universities

13. Is this course part of a proposed new program?  
   If yes, which?  
   □ Yes  ✔ No

14. Will adding this course change the degree requirements in one or more programs?*  
   If yes, explain the change(s) below  
   □ Yes  ✔ No

15. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.

16. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted.

17. Within the Department, who should be contacted for further information about the proposed course?

   Name  Jon C. Yingling  Phone Extension  7=1105

*NOTE: Approval of this course will constitute approval of the program change unless other program modifications are proposed.
# APPLICATION FOR NEW COURSE

## Signatures of Approval:

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
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<tbody>
<tr>
<td>Department Chair</td>
<td>11/19/01</td>
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<tr>
<td>Dean of the College</td>
<td>12/20/02</td>
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*Undergraduate Council

*University Studies

*Graduate Council

*Academic Council for the Medical Center

*Senate Council (Chair)

*If applicable, as provided by the Rules of the University Senate

### ACTION OTHER THAN APPROVAL

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Rev 11/98
SYLLABUS
MFS 612. Design of Lean Manufacturing Systems

(Note: this course was piloted two times during 1999 and 2000 as MFS 599 and MFS 699, respectively. A less technical version of this course has also been taught numerous times as an industrial short course within U.K. Lean Manufacturing Certification Program)

PROPOSED COURSE DESCRIPTION

3 credits. Technical design of manufacturing systems in accordance with lean manufacturing principles. Topics include models for characterization and analysis of factory flow and dynamics, production flow analysis, work cell design, and design of pull-based production control systems. Prereq: MFS 503.

COURSE TEXT:


Various handouts provided by the instructor.


INSTRUCTOR

Dr. Jon C. Yingling
234D MMRB
275-1105
e-mail:jyinglin@engr.uky.edu

Learning Outcomes: upon completion of this course students should be able to:

1. Ascertain the impact of decisions on structure, operation, and control of a factory on performance of that factory in terms such as average WIP levels, throughput times, and capacity.
2. Apply the tools and techniques of production flow analysis as a guide to product family definition and restructuring of a factory to enhance product flows through that the facility.
3. Identify the key features of alternative hybrid cellular manufacturing approaches and application characteristics that make a particular manufacturing structure desirable.
4. Design a group technology work cell, including the issues of capacity balance, manning levels, lot sizing, layout, workstation design, equipment modifications to support operations, line balance, and management structure.

5. Articulate the performance differences between alternative pull-based production control systems and identify application characteristics that make one type of system preferable to another.

6. Identify the structure of an appropriate system for pull based production control for a particular industrial application.

7. Explain how to integrate scheduling with pull-based production control approaches.

TOPICS

1. Factory Physics: Models to characterize and analyze flows through a factory – ideal and worst case system structures; modeling of temporal variability of a process including impacts of preemptive and non-preemptive disruptions; WIP accumulations as a function of variability and process utilization; ramifications of shared processes on system variability; impact of blocking using pull mechanisms on throughput time, throughput rate, and average WIP; impact of setup time and batching on flow; comparison of serial and parallel process structures on flow; effects of inventory segregation; rationalization and refinement of lean management philosophies from the perspective of flow including setup reduction, total productive maintenance, capacity utilization philosophies, etc.

2. Production flow analysis - Burbidge’s hierarchy in production flow analysis; factory flow analysis for department-level restructuring; group analysis using binary order and TSP strategies along with various practical procedure refinements to identify product families and machine groups; advanced PFA techniques including cluster analysis methods and sequence analysis; tooling analysis to define product families and machining sequences on the basis of setup requirements; hybrid cellular manufacturing structures (e.g., modular flow lines, cascading cells) and their practical utility.

3. Detailed design of group technology work cells – performance comparisons among general cell layout configurations (e.g., U-cell, straight line, serpentine); systematic layout planning (SLP) approaches applied to group technology work cell layout; external materials handling system design issues; workstation design including detailed motion analysis considerations; desirable equipment characteristics for lean work cells; line balance and work design including work design objectives, impacts of dynamic imbalance, work design for single product and mixed model lines, special work design strategies (e.g., circulation, bucket brigade, state-dependent signaling) to increase worker utilization, and line balancing algorithms/heuristics (including U-cell line balance with circulating workers); internal production control.

4. Linking work cells and production center with appropriate pull-based production control mechanisms – Review of traditional product-specific pull systems; CONWIP systems; POLCA systems; route-specific kanban; system structuring considerations.
including strategies for dealing with high product variety, location of the push/pull interface, and handling of shared processes; scheduling approaches and their proper integration with the selected pull-based production control mechanism.

Grading

Homeworks (includes exercises in factory physics, factory flow analysis, group analysis, cell layout, and line balance): 40%
Midterm: 30%
Final: 30%