IT 445
Computer-Aided Manufacturing
Spring 2013

Instructor Information
Instructor: Dr. Feng-Chang Roger Chang
Class Meeting Times: 8:00-9:15am, TR
Course Location: EGRA111
Office Hours: 1:30-4:30pm, TR or by appointment, EGRD129
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Course Objective
The objective of this course is to introduce the basic principles and techniques of using computers in the manufacturing activities. Includes the study of production systems, manufacturing operations, manufacturing models and metrics, automation, numerical control, industrial robotics, material transport systems, storage systems, various manufacturing systems, product design and CAD/CAM in the production system, process planning and concurrent engineering, production planning and control systems, just-in-time and lean production, and other modern computer-aided manufacturing techniques and issues.

Course Materials
- Equipment: A hand-held scientific calculator.

Graded Items
- Exam 1 30%
- Final Exam (7:50-9:50am, 5/7/12 Tuesday) 30%
- Quizzes 20%
- Homework 15%
- Class Participations and Attendances 5%

Grading Scale
A: 90-100%
B: 80-89%
C: 70-79%
D: 60-69%
F: <60%

Lessons (Topics)
1. Lesson 1: Production systems
2. Lesson 2: Manufacturing operations
3. Lesson 3: Manufacturing models and metrics
4. Lesson 4: Automation
5. Lesson 5: Numerical control
6. Lesson 6: Industrial robotics
7. Lesson 7: Material transport systems
8. Lesson 8: Storage systems
9. Lesson 9: Introduction to manufacturing systems
10. Lesson 10: Single-station manufacturing cells
11. Lesson 11: Manual assembly lines
12. Lesson 12: Cellular manufacturing
13. Lesson 13: Flexible manufacturing systems
14. Lesson 14: Product design and CAD/CAM in the production system
15. Lesson 15: Process planning and concurrent engineering
16. Lesson 16: Production planning and control systems
17. Lesson 17: Just-in-time and lean production

Student Learning Objectives
At the end of the course, the student should be able to:

- Describe the economic realities of the world that the modern manufacturing enterprises must cope with.
- Describe the modern manufacturing approaches and technologies the manufacturers need to compete successfully.
- Describe facilities in the production systems.
- Describe manufacturing support systems in the production systems.
- Describe automation in production systems.
- Explain the differences between fixed automation, programmable automation, and flexible automation.
- Describe reasons for automating.
- Describe situations in which manual labor is preferred over automation.
- Describe principles and strategies for automation and process improvement.
- Explain the differences between primary industries, secondary industries, and tertiary industries.
- Explain the differences between process industries and discrete product industries.
- Explain International Standard Industrial Classification (ISIC) codes.
- Explain the differences between continuous production and batch production.
- Explain the differences between consumer goods and capital goods.
- Describe manufacturing operations that must be carried out in a factory, which makes discrete products, to convert raw materials into finished products.
- Explain the differences between hard product variety and soft product variety.
- Describe the influence of production quantity and product/part complexity on a plant’s facilities and the way manufacturing is organized.
- Explain the differences between job shop, process layout, and fixed-position layout.
- Compute production performance measures: production rate, plant capacity, equipment uptime proportion, manufacturing lead time.
- Compute manufacturing costs: labor costs, material costs, product production costs, equipment operating costs.
- Describe the basic elements of an automated system.
- Describe advanced automation functions.
- Describe levels of automation in a production plant.
- Describe basic components of an numerical control (NC) system.
- Explain the differences between point-to-point and continuous path control in a motion control system.
- Explain the differences between absolute positioning and incremental positioning.
- Explain the differences between computer numerical control (CNC) and the conventional NC.
- Describe distributed numerical control (DNC).
- Describe the advantages of NC when properly applied in machine tool operation.
- Describe the disadvantages of implementing NC technology.
- Explain the differences between manual part programming and computer-assisted part programming.
- Describe the advantages of CAD/CAM-based NC part programming compared to computer-assisted part programming.
- Describe the joint types used in robotic arms and twists.
- Describe the work volume of a robot manipulator.
- Describe end effector.
- Explain the differences between internal and external robotic sensors.
- Explain the differences between powered leadthrough and manual leadthrough in robot programming.
- Describe control resolution in a robot positioning system.
- Explain the differences between repeatability and accuracy in a robotic manipulator.
- Describe major categories of material handling equipment.
- Describe automated guided vehicle system (AGVS).
- Explain the differences between rail-guided vehicles and automated guided vehicles.
- Describe types of conveyors used in industry.
- Explain the differences between a hoist and a crane.
- Describe measures used to assess the performance of a storage system.
- Describe basic components of automated storage/retrieval systems (AS/RS).
- Describe class-based dedicated storage strategy.
- Describe components of a manufacturing system.
- Explain the differences between fixed routing and variable routing in manufacturing systems consisting of multiple workstations.
- Describe flexibility in a manufacturing system.
- Describe the capabilities that a manufacturing system must posses in order to be flexible.
- Explain why single-station manned cells are so widely used in industry.
- Describe single-station automated cell.
- Describe machining center.
- Describe machine cluster.
- Describe factors that favor the use of manual assembly lines.
- Describe manning level in the context of a manual assembly line.
- Describe line efficiency in production line.
- Explain the differences between cycle time and service time.
- Apply various line balancing algorithms.
- Describe balance efficiency.
- Describe group technology.
- Describe cellular manufacturing.
- Describe part family.
- Apply various methods to solve the problem of grouping parts into part families.
- Explain the differences between a hierarchical structure and a chain-type structure in a classification and coding scheme.
- Describe production flow analysis.
- Describe the principal application of group technology in product design.
- Describe flexible manufacturing system (FMS).
- Explain the differences between a flexible manufacturing cell (FMC) and a flexible manufacturing system (FMS).
- Explain the differences between a dedicated FMS and a random-order FMS.
- Describe the basic components of a FMS.
- Explain the differences between the primary and secondary handling systems in FMS.
- Describe computer-aided design (CAD).
- Describe rapid prototyping.
- Describe virtual prototyping.
- Explain the differences between CAD/CAM and CIM.
- Describe quality function deployment (QFD).
- Describe process planning.
- Describe net shape process.
- Describe benefits of computer-aided process planning (CAPP).
- Describe concurrent engineering.
- Describe design for manufacturing and assembly (DFM/A).
- Describe material requirements planning (MRP).
- Explain the differences between MRP and manufacturing resources planning (MRP II).
- Describe enterprise resource planning (ERP).
- Describe lean production.
- Describe the objectives of a just-in-time production system.

**Late Work Policy**
No late homework will be accepted and missed exams have a 20% penalty unless an appropriate, prior excuse is given to the instructor. The missed exam must be completed on the make-up date set by the instructor.

**SIU Policy on Incomplete Grades**
An INC is assigned when, for reasons beyond their control, students engaged in passing work are unable to complete all class assignments. An INC must be changed to a
completed grade within a time period designated by the instructor but not to exceed one year from the close of the term in which the course was taken, or graduation, whichever occurs first. Should the student fail to complete the course within the time period designated, not to exceed one year, or graduation, whichever occurs first, the incomplete will be converted to a grade of F and the grade will be computed in the student’s grade point average. Students should not reregister for courses in which an INC has been assigned with the intent of changing the INC grade. Re-registration will not prevent the INC from being changed to an F.

Inclusive Excellence
SIU contains people from all walks of life, from many different cultures and sub-cultures, and representing all strata of society, nationalities, ethnicities, lifestyles, and affiliations. Learning from and working with people who differ from you is an important part of your education in this class, as well as an essential preparation for any career.

Student Code of Conduct/Plagiarism
Refer to the following sites for information on the SIU’s student code of conduct and Morris Library’s guide on plagiarism:

SIU Student Code of Conduct:


Emergency Procedures
Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT's website at www.bert.siu.edu, Department of Safety's website www.dps.siu.edu (disaster drop down) and in Emergency Response Guideline pamphlet. Know how to respond to each type of emergency.

Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering with the facility.

Resources for Academic Assistance
Learning Support Services: http://tutoring.siu.edu/
- Provides academic assistance in courses/tutoring

Disability Support Services: http://disabilityservices.siu.edu/
• Provides the required academic and programmatic support services to students with permanent and temporary disabilities

SIUC Writing Center: http://write.siu.edu/
• Offers free tutoring services to all SIUC undergraduate and graduate students and faculty.

SIU Email Policy
Official SIU Student Email Policy: http://policies.siu.edu/policies.email.htm
SIU Student Conduct Code:

Saluki Cares
The purpose of Saluki Cares is to develop, facilitate and coordinate a university-wide program of care and support for students in distress. By working closely with faculty, staff, students and their families, SIU Carbondale continues to display a culture of care by demonstrating to our students and their families that they are an important part of the community. To make a referral to Saluki Cares click, call, or send:
http://salukicares.siu.edu/index.html, (618) 453-5714, or siucares@siu.edu.