ME 221 – Manufacturing Automation

Catalog Description:
Introduction to Computer Integrated Manufacturing (CIM). Fundamentals of automated manufacturing; Computer Numerical Control (CNC); production economics and optimization of production systems.

Prerequisites:
♦ Consent of instructor. Not open to students who have passed ME 386.

Texts:

Course Objectives:
This course introduces the fundamental concepts and elements of computer-aided design and manufacturing. The course exposes students to various aspects of manufacturing, such as: computer integrated design and manufacturing systems, materials management, computer-aided process planning, alternative manufacturing organizations (flexible, open cell concept, etc.) and various production processes.

Topics:
♦ Computer-aided design (CAD) process
♦ Product and process design
♦ Robotics and computer controlled systems
♦ Material-handling and storage systems
♦ Quality engineering
♦ Computer-aided manufacturing
♦ Just-in-time manufacturing systems
♦ Production automation technology

Design Projects:
The team projects will be addressed by teams of two to three students as assigned by the instructor. One of the projects will require an oral presentation; all three will require written reports.

Computer Use:
The use of computational tools is required in written communications and engineering drawings. Students are expected to make use of computer-aided design packages and manufacturing automation software tools.

Evaluation Methods:
Design Projects, Homework, Midterm Exam, Final Exam

Contribution to Professional Component:
This elective course builds upon many of the fundamental design concepts obtained in the required curriculum. Manufacturing automation uses the fundamentals of design and applies them to new product designs and/or manufacturing processes.
Relationship of Course Objectives to Program Educational Objectives:
As an elective course in Mechanical Engineering, ME 221 emphasizes abilities and skills leading to the fulfillment of Program Educational Objective #1: “our alumni practice mechanical engineering by designing systems and solving problems using mathematical, scientific and engineering principles and tools,” Program Educational Objective #2: “our alumni approach engineering decisions with an informed consideration of global and societal contexts and consequences,” and Program Educational Objective #3: “our alumni continue to expand their professional and personal skills and engage in life-long learning.”

Relationship of Course Objectives to ABET 3a-k:

a) an ability to apply knowledge of mathematics, science, and engineering:
   Students gain an ability to apply knowledge of math, science and engineering to both product and process design.

b) an ability to design and conduct experiments, as well as analyze and interpret data: not applicable

c) an ability to design a system, component, or process to meet desired needs:
The course emphasizes the design of products and ultimately the design of the associated manufacturing process through the computer-aided design and manufacturing techniques, such as computer-aided design, computer-aided process planning, control of manufacturing systems, robotics, quality engineering, and just-in-time manufacturing.

d) an ability to function on multi-disciplinary teams:
   Students work in two to three person teams; though not truly multi-disciplinary, students utilize the principles of group dynamics as they work through all the aspects of the designs, including considerations of cost, material specification, production plan etc.

e) an ability to identify, formulate, and solve engineering problems:
   Students learn how various parameters influence the design of the product as well as the process.

f) an understanding of professional and ethical responsibility:
   Students are exposed to aspects of professional responsibility during discussions of the design process and as various codes and standards are cited (e.g. ASME, International Organization for Standardization, etc.) Ethical responsibility is addressed in both the product and process design, as are issues of product and process safety and environmental considerations.

g) an ability to communicate effectively:
   Written reports are required on all of the projects and additionally an oral presentation will be required on one of the projects.

h) the broad education necessary to understand the impact of engineering solutions in a global and societal context:
   Students learn how quality engineering, cost considerations, design functionality, safety issues and environmental considerations affect the ultimate product design.

i) a recognition of the need for, and an ability to engage in life-long learning:
   Various standards, such as ASTM (American Society for Testing Materials) are discussed relative to the product designs. Forefront technologies are discussed such as the wide application of robotics and other new manufacturing technologies within a manufacturing process.

j) a knowledge of contemporary issues:
   Contemporary issues relative to manufacturing processes are discussed: these include environmental impact (e.g., waste management), power utilization and consumption, design for safety and design for end of life.

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice:
   Students utilize CAD (computer-aided design) and CAM (computer-aided manufacturing) packages and manufacturing automation software tools.

Relationship of Course Objectives to Course Outcomes:
1) Students will be able to identify the elements of manufacturing automation; these include CAD/CAM and CNC.
2) Students can identify and understand design process sequence.
3) Students will be able to perform geometric modeling using CAD software.
4) Students will be able to prepare a simple CNC program and produce a sample part.
5) Students will understand machining processes and CNC.
6) Students will understand automated material handling and storage.
7) Students will understand robotics systems.
8) Students will understand the principles of quality engineering and the various methods of automated inspection systems.
9) Students will understand manufacturing planning and control systems and how they impact the quality and cost of the end product.
10) Students will perform simple manufacturing material control calculations using the concepts of just-in-time, kanban systems.

Approval Block:
Prepared by: Z. Bzymek, October 2006
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C&C Approval: N. Olgac, January 2007
Department Head Approval: January 31, 2007