ME 224 – Analysis and Design of Mechanisms

Catalog Description:
Application of kinematics in the analysis and synthesis of mechanisms. Type and dimensional design of linkages, cams and gears based on motion requirements and kinetostatic force transmission, in contrast to the strength requirements. Graphical, analytical and computer methods in analysis and design of mechanisms. Design considerations in mechanism synthesis.

Prerequisites:
- MATH 210
- MATH 211
- CE 211

Texts:

Course Objectives:
This course is designed to teach the Mechanical Engineering juniors and seniors the fundamentals of kinematics of machines and mechanisms as well as the applications of these fundamentals in analysis and design of machines. Upon successfully finishing this course, students will be able to study complex machinery by systematic application of the fundamentals of relative motion of solid links. In this process they will have to use their mathematical and computational skills. The traditional graphical methods used in this subject are, to a large extent, replaced by computer graphics tools. In addition to analysis, significant emphasis is placed on the ability to synthesize and design machines and mechanisms.

Topics:
- Basic kinematics concepts and definitions
- Type analysis
- Position analysis
- Velocity analysis
- Acceleration analysis
- Cam analysis and design
- Gears (spur, bevel, helical, worm, rack)
- Gear Trains
Design Projects:
Three analysis and design projects are required

Computer Use:
Students need to use computer programming as well as Working Model simulation software in solution of problems and design projects.

Evaluation Methods:
Participation, Homework, Quizzes, Project, Final Exam

Contribution to Professional Component:
The course builds upon mathematical and scientific foundations. It provides education in design of machine systems as a predecessor to the capstone design experience.
Relationship of Course Objectives to Program Educational Objectives:
The course 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.”

Relationship of Course Objectives to ABET 3a-k:

a) an ability to apply knowledge of mathematics, science, and engineering:  
   *This course builds upon the foundations in kinematics and dynamics with application to machine design activities. Knowledge in basic engineering science is applied to analysis and design of machine systems.*

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:  
   *Design projects and homework sets provide the students with experience in the design of mechanisms and machine systems.*

d) an ability to function on multi-disciplinary teams: *not applicable*

e) an ability to identify, formulate, and solve engineering problems:  
   *Through projects and homework, students identify engineering problems and formulate methods for their solution.*

f) an understanding of professional and ethical responsibility: *not applicable*

g) an ability to communicate effectively: *not applicable*

h) the broad education necessary to understand the impact of engineering solutions in a global and societal context: *not applicable*

i) a recognition of the need for, and an ability to engage in life-long learning: *not applicable*

j) a knowledge of contemporary issues: *not applicable*

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice:  
   *Students complete their projects using computational tools and software, including programming in their language of choice and use of Working Model software and other appropriate software.*

Relationship of Course Objectives to Course Outcomes:

1) Students should be able to the basic relative kinematics relations of two moving point
2) Students should be able to identify individual links
3) Students should be able to identify and categorize the type of the connection of the links (joints)
4) Students should be able to develop analytical equations describing the relative position, velocity and acceleration of all moving links
5) Students should be able to identify all reaction and inertia forces on the links
6) Students should be able to apply the fundamentals of part I to specific link and joint combinations such as cams and gear systems,
7) Students should be familiar with standards in gear and cam machine components,
8) Students should be able to analyze and design two dimensional (otherwise complex) cam and gear system.

Approval Block:
Prepared by: K. Kazerounian, March 2007
Reviewed by: J. Tang, March 2007
Revised by: K. Kazerounian, April 2007
C&C Approval: N. Olgac, June 2007
Dept. Head Approval: June 2007