University Of California, Berkeley
Department of Mechanical Engineering

ME 130: Design of Planar Machinery (3 units)

Elective Course

Syllabus

CATALOG DESCRIPTION

Synthesis, analysis, and design of planar machines. Kinematic structure, graphical, analytical, and numerical analysis and synthesis. Linkages, cams, reciprocating engines, gear trains, and flywheels.

COURSE PREREQUISITES

ME 104.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

E36 (Statics); ME 140 (Dynamics); calculus and vector analysis; familiarity with CAD; junior or senior standing in ME field.

Required textbook: R.L. Norton, "Design of Machinery: An Introduction to Synthesis and Analysis of Mechanisms and Machines," 3rd edition, McGraw-Hill Inc., 2004.

Instructor-created, animated Powerpoint presentations as reference.

COURSE OBJECTIVES

To introduce various techniques for mechanism synthesis and analysis; to design and fabricate a mechanical device to perform a desired task; to learn to work as a member of a design team.

DESIRED COURSE OUTCOMES

Upon completing the course, the students will be able to: Understand the concepts of joints, linkages, mechanism classifications, mechanical advantage, minimum transmission angles and degrees of freedom; synthesize a mechanism using graphical and analytical methods for a given path, motion or function generation task; perform kinematic analysis to obtain position, velocity, and acceleration of a designed mechanism; perform kinetic analysis to determine joint and link forces and calculate the input torque needed to power a mechanism; use cam and follower in designing mechanisms; understand the concept of team work and team dynamics; obtain hands-on experience in taking a design concept through building the prototype and testing it to meet certain specifications.

TOPICS COVERED

Introduction to mechanisms, kinematics pairs, and degrees of freedom. Four-bar mechanism, mechanism classification, transmission angle, mechanical advantage, toggle positions, and Grashoff mechanism. Graphical synthesis: motion generation mechanisms, two and three positions with and without prescribed fixed pivot points. Graphical synthesis: adding Dyad to mechanisms, quick-return mechanisms Graphical synthesis: path generation mechanism (three positions) with and without timing. Graphical synthesis: function generation mechanisms. Analytical synthesis: complex polar notation, closed loop vector equation. Analytical synthesis: standard Dyad equation, motion generation mechanisms for two to five positions. Analytical synthesis: path and function generation mechanisms, Chebychev spacing. Analytical analysis: using complex polar notation to obtain position, velocity and acceleration. Graphical analysis: instant center and polygon methods. Static and dynamic forces on mechanisms, graphical and analytical methods (matrix method), torque requirement. Cam design: cam and follower type, displacement, velocity, acceleration and jerk profiles, high speed cams. Static and dynamic balancing of mechanisms.

CLASS/LABORATORY SCHEDULE

Three hours of lecture and one hour of laboratory per week.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Students apply math, science and engineering knowledge to design and analyze mechanical devices. Students gain hands-on experience in designing, building and testing a mechanical device to meet certain specifications. This provides our students with an insight to the practical aspects of design. Students use various computer tools for technical drawings, modeling, simulation and analysis; parametric modelers such as SolidWorks and ProE, Working Model for preliminary design. Students prepare a technical report and make a presentation. Design project provides an opportunity for team work and organizing the design phases and budgeting the time effectively to meet design deadlines.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

An ability to apply knowledge of mathematics, science, and engineering; an ability to design a system, component, or process to meet desired needs; an ability to identify, formulate, and solve engineering problems; an ability to communicate effectively; a knowledge of contemporary issues; an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

Weekly homework assignments, some with open-ended problems. Two midterm exams and a final exam. Semester design project.

PERSON(S) WHO PREPARED THIS DESCRIPTION: K. Youssefi Feb. 26, 2006