ME 442 Design of Machinery (4 Units) Technical Elective

Course Description: (2019-20 Catalog)  
Graphical synthesis and analysis of mechanisms and machines. Analytical fundamentals for study of displacements, velocities, accelerations, and static and dynamic forces necessary for design of planar linkages and gearing systems. Creative design projects using software simulation tools.

3 lectures, 1 laboratory.

Prerequisite Courses:  
ME 212.

Prerequisites by Topic:  
The student is expected to have a working knowledge of dynamics.

Textbook: (and/or other required material)  

Laboratory Manual

References:  
None

Course Coordinator/Instructor: Xi Wu, Professor of Mechanical Engineering

Course Learning Outcomes:  
On completion of this course students will be able to:

1. Apply newly learned skills of mechanism/machine synthesis and analysis to designing creative solution to real-world engineering problems using CAD and ADAMS software.

2. Get familiar with design process of the mechanisms starting from recognition of functional requirements.

3. Synthesize four-bar mechanisms using graphical and analytical methods for given motions or functional generation tasks.

4. Do kinematics analysis of mechanism to determine position, velocity, and acceleration of all members.

5. Do kinetics analysis of machine to determine the forces on all joints and/or the torque required to drive the system.

6. Accomplish term project by designing, synthesizing and analyzing mechanisms based on specific functional needs. Write short technical reports in a professional manner.
Relational of Course to Mechanical Engineering

Student Outcomes:
- SO 1: M
- SO 2: M
- SO 3: M
- SO 4:
- SO 5:
- SO 6:
- SO 7:

Topics Covered:
- Introduce and define kinematics, kinetics, mechanism and machine
- Kinematics Fundamentals
- 4-bar Linkage Synthesis with two design positions
- 4-bar Linkage Synthesis with three design positions and fixed pivots
- Synthesize quick-return mechanisms with specified time ratio
- Synthesize four-bar and six-bar quick-return linkages
- Synthesize dwell mechanisms using coupler curves
- Vector position analysis for four-bar linkages
- Analytical linkage synthesis with two design positions
- Design using Freudenstein’s Eq. and Chebyshev spacing
- Cam-follower design
- Four-bar linkage velocity analysis
- Four-bar linkage acceleration analysis
- Four-bar linkage dynamic force analysis

Laboratory Projects:
- Power hacksaw Analysis using ADAMS
- Slider-Crank Mechanism Design for Washing Machine
- Conveyor Feed Mechanism Design and Analysis
- Whitworth Quick-Return Mechanism Design and Analysis
- Design a Six-link Dwell Mechanism Using a Coupler Curve
- Windshield Wiper Design and Analysis
- 3-week individual term project
  - tackle specific engineering design challenges
  - integrate design and analytical skills from ME442 into projects

Class/Lab Schedule:
- Three 50-minute lectures per week; One 170-minute lab per week

Contribution of Course to Meeting the Professional Component:
(a) College-level mathematics and basic sciences: 0 credits
(b) Engineering Topics: 3 credits
  - Design 1 credit
(c) General Education: 0 credits

Prepared by: Xi Wu  Date: 07/23/2020