Course: ME 36100 – Kinematics and Dynamics of Machinery

Type of Course: Required for ME program

Catalog Description: Position, velocity, and acceleration analysis and design of machine elements including n-bar linkages, programmable mechanisms, and gear trains, dynamic force analysis and balancing of linkages; flywheels.

Credits: 3

Contact Hours: 3

Prerequisite Courses: ME 16000, ME 25100, and MA 36300

Corequisite Courses: None

Prerequisites by Topics: Machines, kinematics, dynamics, differential equations, motion simulation, displacement, velocity, acceleration, force, torque, power, Newton’s motion laws, vibration, computer aided design, linear equations, vectors, matrices.


Course Objectives: Understand the kinematics and dynamics of mechanical elements such as linkages, gears, and cams and learn to design such elements to accomplish desired motions or tasks.

Course Outcomes: Upon successful completion of this course, students should be able to:

- Understand types of motion (1)
- Understand types of joint (1)
- Use degrees of freedom to analyze mobility conditions (1,2)
- Construct and analyze vector loop equations (1,2)
- Analyze forces and torques of components in linkages (1,2)
- Understand static and dynamic balance (1)
- Understand forward and inverse kinematics of open-loop mechanisms (1)
• Apply computing tools to solve kinematic and dynamic problems (1,2)
• Communicate effectively through reports and presentations (4,7)

Lecture Topics

1. Machine kinematics (14 lectures)
   • Overview
   • Degrees of freedom
   • Links and joints
   • Grashof condition
   • 4-bar linkage, slider-crank, and inverted slider crank

2. Machine Dynamics (11 lectures)
   • Newtonian solution method
   • Force analysis of linkage
   • Shaking force and torque
   • Balancing linkage
   • Flywheels

3. Gears and gear trains (9 lectures)
   • Terminologies of gears and gear trains
   • Interface, undercutting, contact ratio
   • Simple gears and compound gear trains
   • Planetary gear trains

4. Cam systems (3 lectures)
   • Cam terminologies
   • Cam function design and sizing

5. Programmable mechanisms (8 lectures)
   • Introduction to industrial manipulators
   • Kinematic chains and classifications
   • Coordinate transformation
   • Forward and inverse kinematics

6. Exams (3 lectures)

Computer Usage
High

Laboratory Experience
None

Design Experience
Medium

Coordinator
Zhuming Bi, Ph.D.

Date
March 26, 2018