

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 with a minimum grade of C-, ME 25100 with a minimum grade of C-, 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.
Textbook	R. L. Norton, <i>Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines</i> , McGraw-Hill, current edition.
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: 1. Understand types of motion (1) 2. Understand types of joint (1) 3. Use degrees of freedom to analyze mobility conditions (1,2) 4. Construct and analyze vector loop equations (1,2) 5. Analyze forces and torques of components in linkages (1,2) 6. Understand static and dynamic balance (1) 7. Understand forward and inverse kinematics of open-loop mechanisms (1)

8. Apply computing tools to solve kinematic and dynamic problems **(1,2)**
9. 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

Bongsu Kang, Ph.D.

Date

14 December 2022