

## ME 45900 – Mechanism and Machine Theory

### Course Outcomes [Related ME Program Outcomes in brackets]

1. An understanding of the *kinematics of mechanisms*. [1]
2. An understanding of the *kinetics and dynamics of machines*. [1]
3. Enhance *problem-solving* techniques in mechanism and machine theory. [1, 2, 3]
4. Appreciation of the design of different types of *machinery*. [1]

### Kinematics of Mechanisms (5 weeks)

1. Synthesis and Mobility.
2. Posture, Velocity and Acceleration Analysis.
3. Analytical and Numerical Methods.
4. Curvature of a Point Trajectory.
5. Rolling and Slipping Contact.

### Dynamics of Machines (5 weeks)

1. Inertia Forces of High-Speed Machinery.
2. Critical Speeds of a Shaft.
3. Shaking Forces and Shaking Moments.
4. Balancing of Machines.
5. Equation of Motion for a Machine.

### Applications (5 weeks)

1. Design of Linkages.
2. Mechanisms with Springs and Dampers.
3. Balancing of Reciprocating Masses.
4. Design of Cam and Follower Mechanisms.
5. Design of Gear Trains.

### Typical Design Projects

- Kinematic Synthesis of Linkages.
- Applications of High-Speed Machines.
- Cam and follower Mechanisms.
- Epicyclic Gear Trains.

**COURSE NUMBER:** ME 45900

**COURSE TITLE:** Mechanism and Machine Theory

**REQUIRED COURSE OR ELECTIVE COURSE:** An elective course.

**SEMESTERS OFFERED:** Fall Semester and Spring Semester.

**TEXTBOOK/REQUIRED MATERIAL:**

Theory of Machines and Mechanisms, Fifth Edition, J.J. Uicker, Jr., G.R. Pennock, and J.E Shigley, Oxford University Press, 2017.

**PRE-REQUISITIES:** ME 27400 Dynamics and ME 35400 Machine Design.

**COORDINATING FACULTY:** G. R. Pennock

**COURSE DESCRIPTION:** Introduction to the principles of the analysis and design of mechanisms and machinery. Design for functionality, motion constraints, inertia force effects, and static and dynamic balancing.

**COURSE OUTCOMES** [Related ME Program Outcomes in brackets]:

1. An understanding of the kinematics of mechanisms. [1]
2. An understanding of the dynamics of machinery. [1]
3. An understanding of machine theory and design. [1]
4. Enhance problem-solving and communication skills. [1, 2, 3]

**ASSESSMENTS TOOLS:**

1. Homework and Quizzes.
2. Design Projects.
3. Formal Reports.
4. Final Exam.

**NATURE OF DESIGN CONTENT:** Design of linkages, cam and follower mechanisms, and gear trains. Design of machinery to meet performance requirements. Analytical and numerical methods are presented to evaluate the design components of a machine. Models are developed to understand the general features of a machine design.

**RELATED ME PROGRAM OUTCOMES:**

1. Engineering fundamentals.
2. Engineering design.
3. Knowledge acquisition for problem solving.
4. Communication skills.
5. Ethical and Professional responsibilities.

**PROFESSIONAL COMPONENT:**

1. Engineering Topics: Engineering Science – 2 credits (50%).  
Engineering Design – 2 credits (50%).

**COMPUTER USAGE:** The design projects will require the students to write computer programs and generate spreadsheets to study the kinematics, kinetics, and dynamics of a particular machine.

**COURSE STRUCTURE/SCHEDULE:**

1. Lectures - 3 lectures per week at 50 minutes per lecture.

**PREPARED BY:** G. R. Pennock

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