MECH3030 Mechanisms of Machinery

Course Code: MECH3030	**Course Title:** Mechanisms of Machinery
Required Course or Elective Course: Required	**Terms Offered (Credits):** Fall 2023-24 (3 credits)
Faculty In Charge: Yanglong Lu	**Pre/Co-Requisites:** MECH2020

Course Structure: Lecture: two lectures per week, 80 mins per lecture
Tutorial: one tutorial session per week, 50 mins per session

Textbook/Required Material:

(1) Lecture PPT notes; (2) Kinematics, Dynamics, and Design of Machinery, 3rd Edition, K. Waldron et al., Wiley.

Bulletin Course Description:

This course aims to introduce the graphical, analytical, and computational approaches in the analysis and design of fundamental mechanisms. Kinematic analysis of mechanisms (e.g., position, velocity, and acceleration analysis of simple planar linkages) and design/synthesis of mechanisms (e.g., four-bar linkages, gear trains, cam, and follower) will be covered in the lectures. The students will also have hands-on experience using a numerical simulation software (e.g., SolidWorks) and MATLAB in the lab session. They are also strongly encouraged to play with the powerful multi-touch app (i.e., MotionGen) after class.

Course Topics:

1. Introduction: fundamentals of mechanisms, links, and joints; constrain analysis and mobility of planar linkage; inversion; Grashof's theorem.
2. Position analysis: graphical and analytical approaches; vector loop method.
3. Velocity analysis: graphical and analytical approaches; instant center of velocity.
4. Acceleration analysis: graphical and analytical approaches; Coriolis acceleration; jerk analysis.
5. Design and synthesis of planar linkage: graphical and analytical synthesis of four-bar linkage for double-rocker, crank-rocker, two-positions, and three-positions.
6. Fundamentals of involute spur gear.
7. Gears trains: terminology in gears; gear types; fundamental law of gearing; gear trains.
8. Cam design: fundamental of cam and follower; cam terminology; RFDF and RFD cam design.

Course Objectives: (correlated program objectives)	1. Develop an understanding of various classes of linkages, concepts of mobility and function (P-O3) 2. Develop knowledge of basic graphical and analytical methods of linkage synthesis (P-O3) 3. Develop a working knowledge of a linkage design and analysis software package (P-O3) 4. Develop ability to perform position, velocity, acceleration and force analysis on linkages and machines (P-O3, P-O4) 5. Develop an understanding of the basic balancing techniques of rotating machinery (P-O1, P-O3, P-O4)
Course Outcomes: (correlated course objectives and program outcomes)	On successful completion of this course, students are expected to be able to: A. Analyze the basic relative kinematics relations of two moving rigid bodies. [1] (POC1, POC3) B. Identify individual links. [1,2] (POC1, POC3) C. Identify and categorize the type of connection of the links (joints). [1,2] (POC1, POC3)

	D. Develop analytical equations describing the relative position, velocity, and acceleration of all moving links. [2,3,4,5] (POC1, POC3) E. Design simple 4-bar linkages to realize angle mapping, two-positions, or three-positions motion sequence. F. Apply the fundamentals of mechanisms to specific link and joint combinations such as cams and gear systems. [2,3,4,5] (POC1, POC3, POC4, POC6) G. Describe standards in gear and cam machine components. [5] (POC3, POC4, POC9) H. Analyze and design two-dimensional (otherwise complex) cam and gear system. [3,4,5] (POC1, POC3, POC4, POC6)
Assessment Tools: (Correlated course outcomes)	1. Homework: 10% [A-H] 2. Tutorial assignments and MATLAB labs: 10% [A-H] 3. Mid-term exam: 35% [A-H] 4. Final exam: 45% [A-H]

BEng in Mechanical Engineering (4-year program)

Program Objectives:

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,

P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,

P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,

P-O4. Clearly consider the ethical implications and societal impacts of engineering solutions,

P-O5. Continuously improve through lifelong learning.

Program Outcomes:

POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;

POC2. ability to design and conduct experiments as well as analyze and interpret data;

POC3. ability to apply knowledge of mathematics, science, and engineering for problem-solving in mechanical engineering and related sectors or for further education in a research career;

POC4. ability to develop specification and to design system, component, or process to meet needs;

POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;

POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;

POC7. ability to communicate effectively;

POC8. ability to function in multi-disciplinary teams and provide leadership;

POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;

POC10. clear understanding of professional and ethical responsibilities;

POC11. recognition of the need for life-long learning and continuing education;

POC12. international outlook with knowledge of contemporary issues.