Semester	Fall 2024
Course Number	Technical Elective
Course Title	MATLAB-Simscape for Engineering Applications
Instructor	Professor Ping C. Sui, Ph.D., E-Mail: ping.sui@scupi.cn Office: N502, SCUPI Jiang'an South Campus
Teaching Assistant	郭赵熙 (E-Mail: 2021141520046@stu.scu.edu.cn)
Office Hours	Tuesday 13:00-17:00; Wednesday 13:00-17:00
Class Time	Thursday 13:50-16:25
Lecture Room	SCUPI Zone 4-212
Prerequisites	Engineering 0011 Introduction to Engineering Analysis (or prior MATLAB training) ME 1015 Rigid-Body Dynamics Mechanical Engineering Major Experience in Simulink is a plus.
Textbook	Eric Constants and Karl B. Dyer, 2019, Introduction to Mechanism Design with Computer Applications, 2019, CRC Press, Taylor & Francis Group, Boca Raton, FL.
Technical References	John J. Uicker, Jr., GordonR. Pennock. and Joseph E. Shigley, 2017, Theory of Machines and Mechanisms, 5th Edition, Oxford University Press, New York, NY. For MATLAB Background: Magrab, E.B., Azarm, S., Balachandran, B., Duncan, J.H., Herold, K.E., Walsh, G.C., 2011, An Engineer's Guide to MATLAB, Prentice Hall, Upper Saddle River, NJ
Course Description	This class serves as an introduction to the design and analysis of **mechanisms** and their associated motions and forces using computer-aided design tools. Applications of the analyzed mechanisms are focusing on the two-dimensional type (or planar mechanisms). The level of this course assumes the attending students are fluent in calculus, linear algebra, differential equations, and engineering mathematics, can employ the engineering approach to problem solving, and has experience in using MATLAB models to predict the response of elements, devices, and systems. In terms of MATLAB, the course has two interrelated parts. The first part briefly reviews the fundamentals of MATLAB syntax and commands for structured programming techniques. Students will use applied mathematical techniques, plotting, logic operations, and graphical user interfaces to design, test, and debug numerical algorithms in solving linear/nonlinear differential equations. The second part makes use of MATLAB skills and learn MATLAB Simscape toolbox at the same time. Objective is to apply Simscape for numerical solutions for a wide range of engineering problems with application examples on multibody dynamics modeling, mechanism motion analysis, gear train analysis, etc.
Course Features	This is a project-based course rather than a topic-based course, and students will learn the MATLAB Simscape computational and problem-solving skills needed to complete the projects rather than progressing through a typical programming text.

Class Outline

Weeks	Covered Topics

2	I. Course Overview II. MATLAB Simulink and Simscape Modeling
3	III. Fundamentals of Kinematics IV. Mathematical Concepts in Kinematics a. Numerical Methods for Motion Analysis b. Advanced Topic: The Newton–Raphson Method V. Position Analysis of Planar Mechanisms VI. Velocity Analysis of Planar Mechanisms VII. Acceleration Analysis of Planar Mechanisms
1	**Section Exam 01**
4	VIII. Simscape Fundamental a. Simscape and Simulink b. Simscape Fundamental Library IX. SimMechanics and SimMultibody a. Single- DOF Dynamic System Analysis b. Multi-DOF Dynamic System Analysis c. Closed-Loop, 2D Planar Mechanisms
1	**Section Exam 02**
3	X. Static Force Analysis of Planar Mechanisms XI. Dynamic Force Analysis of Planar Mechanisms XII. SimMechanics Multibody Dynamic Analysis XIII. SimMechanics Geartrain Systems Analysis XIV. SimMechanics Multibody Contact Analysis
1	**Section Exam 03**
1	**Project Presentation**

In-Class Workshops	Hands-on practice will be given during the class throughout the semester. The purpose is to promote in-class discussions and keep students in-sync with course material during lecturing.
Lab Assignments	Problem sets for practicing the learned analytical and modeling skills will be distributed each week after the class. Each assignment set is designed to build upon the material covered in the preceding lectures and recitations. Task assigned in a particular class is due at 11:00 AM on the day of the next class period, unless otherwise posted. Late assignment will not be accepted.
Final Project	There will be a final project. Details will be furnished later. Expected deliverables: • Developed project models • Written final report • In-Class Oral Presentation
Section Exams	Three section exams. Exams in this course will be open-book and open-notes. No make-up will be given for the missing exam. Exams missed due to unpredictable events will be dealt with on a case-by-case basis.
Grades	Lab Assignments 20% Section Exams: 60% Final Project: 20%

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Class Attendance	Students are expected to attend every class period. Early is on time, on time is late. As a courtesy to your fellow classmates, be punctual and arrive no later than the class starting time.
Academic Honesty	All of us are equally responsible for ensuring a fair and positive learning environment. Students are permitted to discuss homework assignments together, but should do their own work when preparing a problem solution. All exams are to be completed without unauthorized assistance. Any student caught cheating on an assignment or exam will receive disciplinary action, up to and including receiving a grade of “F” for the course.