ECE 4500/5500: Robotic Systems and Control
Winter 2018 Syllabus

Instructor:	Dr. Khalid Mirza, 338 EC, (248) 370-4629, mirza@oakland.edu
Office Hours:	M/W: 1:00PM – 2:00PM, or by appointment
Textbooks:	J. J. Craig, "Introduction to Robotics, Mechanics and Control", 3rd Edition, Prentice Hall, 2005, ISBN 978-0-201-54361-2
References:	1. M. W. Spong, S. Hutchinson and M. Vidyasagar, *"Robot Modeling and Control"*, John Wiley & Sons, NJ, 2006, ISBN 978-0-471-64990-8 2. B. Siciliano, L. Sciavicco, L. Villani and G. Oriolo, "Robotics: Modelling, Planning and Control", 1st Edition, Springer, 2009, ISBN 978-1-84996-634-4
Course Website:	Moodle will be used for the class website where all lectures, homework assignments and projects. Go to: https://moodle.oakland.edu/moodle/login/index.php and log in using your OUCA UserName and Password. Click on ECE-4500-11347.201810 or ECE-5500-11348.201810.

University Catalog Description:

ECE 4500/5500 - Robotic Systems and Control (4 credits)
Introduction to robotic systems and applications. Robotic forward and inverse kinematics. Task and path planning with motion controls. Jacobian matrix, differential motion and robotic statics. Redundant robots, mobile robots and multi-robot coordination. Robotic dynamics, position control and force control. Computer simulation and laboratory demonstration. Offered fall or winter. (Formerly ECE 423/523)
Prerequisite(s) for ECE 4500: (ECE 335 or ECE 3204) and major standing.

Course Objectives:

By the end of this course you should be able to:

1. Model and analyze serial-chain robotic systems.
2. Solve forward and inverse kinematics for a robotic manipulator.
3. Determine the Jacobian matrix for a robotic system.
4. Formulate and solve for robot trajectory planning.
5. Develop an understanding of redundant robots and multi-robot coordination.
6. Develop an understanding of robotic statics, joint-servo control and dynamic control.
7. Practice computer simulations and gain hands-on experience on industrial robots.

ABET/Program Outcomes:

Upon successful completion of this course, you should be able to demonstrate your skills in part a, c, e, g, h, i, j, and k of the following key areas:

a. an ability to apply knowledge of mathematics, science, and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multi-disciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Homework:

Homework will be assigned throughout the course. You are expected to work individually on your homework assignments. Failure to do so will most likely result in poor performance in the course. These assignments will also require the use of MATLAB and other simulation programs.

Team Projects:

Team projects will be assigned throughout the course. You are expected to work in assigned teams on your project assignments. These assignments will also require the use of MATLAB and other simulation programs.

Laboratory:

The course will have associated labs designed to gain hands-on experience on state-of-art industrial robots. These labs will be held in time-slots outside of the class lecture time in the Industrial Robotics Laboratory located in EC 357. A list of available time-slots for the labs will be posted and you will need to select one that fits your schedule.

Lab 1	Introduction to Industrial Robots – Safety, Programming and Coordinate Frames
Lab 2	Forward Kinematics – Joint Motion
Lab 3	Inverse Kinematics – Cartesian Motion
Lab 4	Project Lab – Application Programming

Exams:

There will be a midterm and a final exam. Make-up exams will not be given in any event! If an excused emergency arises, then a future test will be weighted appropriately to compensate for the missed exam.

Grading:

The final grade will be based on the following weights:

Homework	15 %
Team Projects	20 %
Labs	15 %
Mid-term Exam	20 %
Final Exam	30 %
	100 %

Academic Conduct:

Students are encouraged to discuss homework and laboratory assignments with one another for their mutual benefits. However, no form of plagiarism (for example, copying) is permitted. Cheating on exams/projects will not be tolerated. Any student found responsible for cheating by the Academic Conduct Committee will receive a 0.0 in this course in addition to the penalty designated by the committee. Students are expected to read, understand and comply with the Academic Conduct Regulations of Oakland University, found at https://oakland.edu/deanofstudents/student-code-of-conduct/philosophy-and-purpose/.