ELEC 5530/6530– Robot Control

Summary: This course covers the design, analysis, and simulation of robotic manipulator control. Students will explore kinematics, inverse kinematics, equation of motion, various control strategies, including classic computed-torque feedback control, modern optimal control, and AI-based methods such as reinforcement learning and neural network control. The course emphasizes hands-on practice, enhancing MATLAB programming skills through homework and exams.

Prerequisite: Introductory physics, ELEC3500 or basic control course.

Textbook: *F.L. Lewis, D.M. Dawson, and C.T. Abdallah, Robot Manipulator Control: Theory and Practice, 2nd edition, Revised and Expanded, CRC Press, Boca Raton, 2006.*

Coordinator: Bosen Lian, Assistant Professor of Electrical & Computer Engineering

Lecture Topics:	Class schedule (40 50minute classes)
1. Computer Simulation	(3 classes)
2. Kinematics	(5 classes)
3. Inverse Kinematics	(3 classes)
4. Jacobian	(2 classes)
5. Lagrange-Euler Robot Dynamics	(5 classes)
6. Computed-Torque Control	(5 classes)
7. Optimal Control	(3 classes)
8. Reinforcement Learning Control	(4 classes)
9. Neural Network Based Control	(4 classes)
10. Homework discussions	(4 classes)
11. Test	(2 classes)

Grading Policy

Category	ELEC 5530	ELEC 6530
Overview	10%	10%
Homework	40%	40%
Final exam	35%	20%
Project	15%	30%

Computer usage: Students will use basic MATLAB languages to solve homework problems.

Class attendance: Class attendance and its effect on course grade are the prerogative of the individual instructor and will be part of the course outline and announced the first day of class.

Justification for Graduate Credit in ELEC 6530: Graduate students in ELEC 6690 have a more advanced project than their ELEC 5530 counterparts and also have the additional requirement of a paper/presentation

Accommodations: Students who need accommodations are asked to arrange a meeting during office hours the first week of classes, or as soon as possible if accommodations are needed immediately. If you have a conflict with the instructor's office hours, an alternate time can be arranged. To set up this meeting, please contact the instructor by E-mail. Bring a copy of your

Accommodation Memo and an Instructor Verification Form to the meeting. If you do not have an Accommodation Memo but need accommodations, make an appointment with The Program for Students with Disabili.es, 1244 Haley Center, 844-2096 (V/TT).

Academic Honesty Policy: All portions of the Auburn University student academic honesty code (Title XII) found in the Tiger Cub will apply to this class. All academic honesty violations or alleged violations of the SGA Code of Laws will be reported to the Office of the Provost, which will then refer the case to the Academic Honesty Committee.

Student Learning Outcomes*:*

1. Students will understand basic Robot geometries, kinematics, inverse kinematics, and Jacobian.
Assessment- Homeworks, examinations, and project.
2. Students will understand classical computed-torque control techniques such as PD and PID control, and classical PD-gravity control, PD and PID control.
Assessment- Homeworks, examinations, and project.
3. Students will be able to design various Robotic controllers using MATLAB computer simulation toolboxes.
Assessment- Homeworks, examinations, and project.
4. Students will learn topics on up-to-date learning-based control techniques.
Assessment- Homeworks, examinations, and project.
5. Students will understand the context of control systems design including the history of robots and ethical responsibilities of engineers.

Prepared by: Bosen Lian Date: 02/17/2025