EE476: Control Design & Labs

http://www.ece.iastate.edu/~rkumar/EE476

	Course-Instructor	Course-TA
Name:	Ratnesh Kumar	See Canvas
Email:	rkumar	
Office Hr:	See Canvas	

Texts/Refernces:

1. Modern Control Engineering, by K. Ogata, Pearson, 2010.
   Programmable Logic Controllers, by F. Petruzella, McGraw Hill, 2017.
2. References on Matlab:
   Feedback Control Systems: The MATLAB/Simulink Approach, by F. Asadi, R. E. Bolanos, J. Rodríguez, Morgan & Claypool Publishers, 2019.
   State-Space Control Systems: The Matlab/Simulink Approach, by F. Asadi, Morgan & Claypool Publishers, 2019.

Course Content (subject to modification):

1. DC Motor Control Trainer: Modeling, Position Control, Speed Control
2. Pendubot Experiment: Modeling, Stabilization, Pole-placement, Swing-up Control
3. Quadrotor Experiment: Modeling, Routing, Obstacle Avoidance
4. Programmable Logic Controllers (PLC) and Industrial Trainer: Assembly line PLC control

Grading Scheme:

- This course is Lab-oriented, with weekly labs for each section, and also a combined lecture each week.
- Each week each student will do one prelab and one lab. **Prelab reports are done individually** and due on the day of the lab, and **lab-reports are done in groups** and due on the day of the next lab. Those will be uploaded through Canvas.
- There will be weekly homeworks, **done individually**, due at the class beginning and submitted through Canvas.
- There will be two in class midterm exams, around the 6th and 11th week, respectively. There will be one final exam (in 16th week) that will be comprehensive.
- Make-up or late submission will be allowed only with a prior arrangement with the instructor, or for emergency (eg, medical); adequate documentation should be provided for the same.
- TAs/Graders will supervise the labs and do the grading, so please contact your TAs/Graders for questions regarding your grading first.

The overall distribution of grades is obtained as:

HWs:	12%
Labs:	36%
Midterms:	28%
Final Exam:	24%
Total:	100%

Final letter grade will be assigned based on class score distribution, with average being the cutoff for B or better, and below 50% in exams is an automatic F.

Syllabus Statements: See Canvas.

Learning Objectives:

- **DC Motor Control Trainer:**
  a) Learn the modeling of a linear electro-mechanical system from newton's law.
  b) Learn how to identify and validate the model through experiments and data analysis.
  c) Learn the state-space modeling of linear time invariant system (LTI).
  d) Learn how to draw the block diagram-based representation from the state-space model.
  e) Learn different control system specifications, closed loop poles, open loop poles.
  f) Learn parameter identification based on least square estimation.
  g) Learn how to design PID based control for speed and position.

- **Pendubot Experiment:**
  a) Learn lagrangian principle of modeling
  b) Learn how to derive lagrange's equation.
  c) Learn linear and nonlinear state space modeling, linearization of nonlinear systems.
  d) Learn how to solve LTI system equations.
  e) Learn Stability, Controllability, Pole placement, Feedback Control
  f) Learn the details of nonlinear energy based control.
  g) Learn how to design Swing-up control.

- **Quadcoptor Control:**
  a) Learn Newton-Euler principle of modeling.
  b) Learn the basic structure of autonomous system.
  c) Learn to use Python for waypoint control function application.
  d) Learn obstacle avoidance during navigation.

- **Programmable Logic Controllers (PLC) and Industrial Trainer:**
  a) Learn the basics of programmable logic controllers (PLC).
  b) Learn the ladder logic.
  c) Learn the basics of counter and timer in PLC design.
  d) Learn how to control a manufacturing station using PLC.