Spring 2024

# ECE 431-002: Introduction to Feedback Control Systems

Cong Wang

**Course number and name**
ECE 431
Introduction to Feedback Control Systems

**Credits, contact hours**
3 credits
3 hours per week

**Name(s) of instructor(s) or course coordinator(s)**
Cong Wang

**Instructional materials**
> Chalk talk notes in the lectures
> Reference books:
Control Systems Engineering, Norman Nise, 6th edition
Modern Control Engineering, Katsuhiko Ogata, 5th edition

**Specific course information**
> Catalog description:
Concept of feedback control. Typical feedback control systems. System dynamics by Laplace transform and state space methods. Stability definition and assessment: Routh-Hurwitx criteria. Graphical stability methods: Root locus, Nyquist and Bode plots. Performance evaluation and simulation. Matlab/Simulink used extensively. A good background in Laplace transform and linear (matrix) algebra highly desirable.
> Prerequisites: ECE 333, or ECE 232 and MATH 337

**Educational objectives for the course**
The students will be able to use transfer function-based methods to
> Model dynamic systems and examine their input-output responses;
> Analyze the stability of open-loop and controlled systems;
> Design PID control laws and tune feedback gains to meet stability and performance requirements.

**Brief list of topics covered**
> Introduction to dynamic systems, controls, and feedback
> Modeling with physics and differential equations
> Integral transformations and Laplace transforms
> Transfer functions and frequency responses
> Time response of basic systems
> Block diagrams
> Correlation between time domain and s-domain
> Graphic tools – Bode plots and Nyquist plots
> Stability
> Design of control laws and PID control
> Graphic tools – Root locus
> Performance analysis and compensation