Course name	**ECE 48300 Digital Control System Analysis and Design**
Credit and contact hours	(3 cr.) Class 3
Course coordinator's name	Lingxi Li
Textbook	K. Ogata, *Discrete-Time Control Systems*. 2nd Edition. Prentice-Hall, 1995. ISBN-13: 9780130342812.
Course information	ECE 48300 Digital Control System Analysis and Design (3 cr.) P: ECE 38200. Class 3. An introduction to real-time computer-controlled systems analysis and design in both frequency domain and state space. Sampling theory and its effect on digital control design. Implementation, application, and industrial practice of digital control using digital signal processors and other microprocessors. Matlab/Simulink and its toolboxes are used. Regular computer and lab assignments. **Prerequisites/ Co-Requisite** P: ECE 38200. C: None **Required, Elective, or Selected Elective:** EE Elective, CE Elective
Goals for the course	Upon successful completion of the course, students should be able to 1. Derive discrete-time mathematical models in both time-domain (difference equations, state equations) and z-domain (transfer function using z-transform). [1] 2. Apply sampling and reconstruction processes to signals and systems. [1] 3. Perform analyses for transient and steady-state responses, and for stability and sensitivity of both open-loop and closed-loop linear time-invariant, discrete-time control systems. [1, 2, 6] 4. Design digital controllers to meet specifications and requirements in both the time domain and frequency domain. [1, 2, 6] 5. Use computer-aided tools such as Matlab/Simulink for digital control system analysis and design. [1, 2, 6] 6. Address issues related to real-time implementation in real-world applications using microprocessors/microcontrollers. [1]
List of topics to be covered	1. Introduction: real-time control, theory, design, and implementation (2 classes) 2. Review of the z-transform (2 classes) 3. Sampling and reconstruction of signals: S/H circuit, A/D conversions, PWM, digital sensors (2 classes) 4. DSP controller peripherals (1 class)

	5. Z-plane analysis of discrete-time control systems (2 classes) 6. Realization and implementation of digital controllers/filters: simple digital controller implementation using DSPs (2 classes) 7. Analysis and design in the frequency domain: relation to time-domain characteristics, performance specs, stability, PID design and implementation issues (4 classes) 8. State-space analysis: state-space representation, Lyapunov stability (2 classes) 9. State-space design: pole placement, state estimator design (4 classes) 10. Practical aspects of real-time control implementation: fixed- vs. floating-point, quantization effects, truncation and round-off effects, sampling rate selection, scaling for DSPs (2 classes) 11. Microprocessor implementation using DSPs and other processors (1 class) 12. Design and implementation of real-time controllers: modeling, algorithm development, software development, device simulators, hardware design (2 class) 13. Linear quadratic optimal control: LQR design (3 classes) 14. Advanced topics: system identification, fuzzy logic, neuro-control (1 class)
Syllabi approved by	Lingxi Li
Date of approval	10/23/2021