Course Syllabus for ECE 592-085

Title	**Digital Control System Projects**
Semester	Fall 2019
Instructor/TAs	Troy Nagle, 919-515-3578 TBD TBD EB2-3080, nagle@ncsu.edu
Prerequisites	Graduate standing and a basic course in digital control systems, or consent of instructor
Credit Hours	3
Class Hours	MW 4:30 PM to 5:45 PM, TEX 2203
Office Hours	MW 2:30 PM to 4:00 PM, in EB2-2024. Others by appointment for in-person, telephone, or Skype
Website	http://wolfware.ncsu.edu
Learning Outcomes	1 Apply principles of digital control theory to model physical sampled-data systems. 2 Design practical digital control schemes in the time domain (state space). 3 Implement digital control schemes using MATLAB and Simulink. 4 Test hardware implementations of digital control schemes against system design and performance specifications.
Required Textbooks	Course materials are posted on Moodle.
Course Overview	Feedback control is important in many areas of electrical, computer, and biomedical engineering, areas such as robotics, mechatronics, communications, power electronics, networking, and numerous medical therapeutic and diagnostic devices. Microcontrollers for embedded applications have grown powerful, ubiquitous, and relatively inexpensive. Therefore, over the last several decades digital control has been rapidly replacing analog implementation. Digital solutions to control problems are more flexible due to their reprogrammable nature, less sensitive to aging and noise, and generally much less expensive to build and maintain than equivalent analog designs. Digital solutions also allow for efficient implementation of state control for multi-input, multi-output systems. In comparison, analog implementations of state control are cumbersome and impractical. There are many details involved in analysis, design, and implementation of digital control systems which are not covered in analog controls courses, such as sampling and reconstruction, finite word-length effects, and analysis of systems with mixed analog and digital signals. This course requires a hardware-based project focused on state control. This course gives students an opportunity to tackle significant, real-world projects.
Course Structure	Two lecture periods each week, plus one semester-long project for student teams of four to six members. Textbook review lectures are posted to the Web in the form of PowerPoint files with sound inserts. Students can download the files from the course Website and view the contents at their convenience. Other class sessions are held to discuss the assigned projects, to hear student project presentations, and for lectures on topics not covered in the text.
Technology Requirements	Students need ready access to MATLAB and SIMULINK through university facilities and their own personal computers.

Lecture Topics	1 Review of digital systems and z transforms 2 Ideal sampling, E*(s), and the modified z-transform 3 State variable models; Continuous and discrete state variable equations 4 Mapping the s-plane into the z-plane 5 Review of digital controller design, control system specifications, compensation 6 Pole-assignment design, state estimation 7 System identification methods 8 Introduction to modern control 9 Case studies and team project options
Projects & Tutorial Papers	Students will be placed in teams of four-to-six members. Each student team will investigate a project topic and prepare a tutorial paper and presentation for the class. A list of recommended topics will be provided to the class. The student groups may also propose their own topic for approval.
Schedule	Will be posted on Moodle.
Course Grading	1 Take-home midterm exam 25% 2 Tutorial paper and presentation 15% 3 Project presentation & demo 25% 4 Team project report 35%
Grading Scale	A+ 97.0-100% A 93.0-96.9% A- 90.0-92.9% B+ 87.0-89.9% B 83.0-86.9% B- 80.0-82.9 % C+ 77.0-79.9% C 73.0-76.9% C- 70.0-72.9% D+ 67.0-69.9% D 60.0-66.9% F < 60.0%
Incomplete Grades	Incomplete as a course grade will be awarded only for work not completed during the course due to conditions deemed by the instructor to be beyond the reasonable control of the student. For undergraduate students, unless an extended deadline is authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The University policy on incomplete grades is located at: http://www.ncsu.edu/policies/academic_affairs/grades_undergrad/REG02.50.3.php . For graduate students, if an extended deadline is not authorized by the Graduate School, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions) or (b) by the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The University policy on incomplete grades is located at: http://www.ncsu.edu/policies/academic_affairs/grades_undergrad/REG02.50.3.php .

	Additional information relative to incomplete grades for graduate students can be found in the Graduate Administrative Handbook in Section 3.18.F at: http://www.ncsu.edu/grad/handbook.
Policy on Late Assignments	Assignments are due on or before the time and date indicated on the assignments. Due dates can be extended for students with valid reasons as defined by the NCSU Attendance policy at: www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.3.php. In cases where the conflict can be anticipated, prior arrangements must be made with the instructor to receive an extension. In cases of illness or family emergency, the student may be required to present documentation or other proof to receive an extension. Late assignments without a valid excuse will be reduced in grade by 50%.
Academic Integrity Statement	Students shall follow the *NCSU Code of Student* Conduct which may be found at: http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php. In addition, your signature on any test or assignment means that you neither gave nor received unauthorized aid. In other words, your signature on to-be-graded work in this course communicates an understanding of, and adherence to, the University Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."
Attendance Policy	Students are expected to attend class. It is the student's responsibility to obtain assignments and information for any missed classes. For NCSU attendance regulations, refer to the academic policy and regulations website at: http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.3.php.
Students with Disability Policy	Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students (http://www.ncsu.edu/dso) at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at: http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.1.php.
Anti-Discrimination Statement	NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at: http://www.ncsu.edu/policies/campus_environ, or http://www.ncsu.edu/equal_op. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 515-3148."