ECE 5554: Powertrain Control Systems

Course Description

Application of digital control system theory, from viewpoints of input-output and state variable representations, to realistic problems in automotive powertrain systems.

Prior Course Number: 753.01
Transcript Abbreviation: Powertrain Control
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Junior, Senior, Masters, Doctoral
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Odd Years
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 3551, 5551, or 551, or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.
Exclusions: Not open to students with credit for 753.01.
Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Gain a basic understanding of automotive electronics, sensors, and typical control modes for internal combustion engines and automatic transmission systems
Learn principles of control-oriented modeling of realistic automotive powertrain systems
Develop tools for analysis and design of discrete-time control systems, using Z transforms
Develop tools for analysis and design of discrete-time control systems, using state-variable techniques

Become proficient in computer-aided analysis and design using Matlab and Simulink

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Powertrain systems, automotive electronics, sensors and actuators	4.0							
Control-oriented modeling of powertrain systems (input-output and state variables)	4.0							
Overview and review of digital control principles as applied to powertrain systems, including Z-transform for design, and state variable techniques	4.0							
The idle speed control problem, analysis, modeling, and control system design (multivariable control)	8.0							
The air-to-fuel ratio control problem, analysis, modeling, and control system design	8.0							
Estimator design and observability for idle speed control and air-to-fuel ratio control	4.0							
Introduce students to Linear Quadratic Regulator (optimal control) as applied to multivariable powertrain control systems	2.0							
Transmission systems control modes	3.0							

Representative Assignments

Homework problems are assigned based on realistic automotive powertrain system models
Significant project using a simulation constructed in Simulink, with feedback control implemented in simulation

Grades

Aspect	Percent
Homework assignments	50%
Quizzes	20%
Project	30%

Representative Textbooks and Other Course Materials

Title	Author
Automotive Electronics	Jurgen
Digital Control of Dynamic Systems	Franklin, Powell and Workman

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
***	c	An ability to design a system, component, or process to meet desired needs.
**	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.

Course Contribution		College Outcome
*	f	An understanding of professional and ethical responsibility.
**	g	An ability to communicate effectively.
**	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
*	i	A recognition of the need for, and an ability to engage in life-long learning.
**	j	A knowledge of contemporary issues.
***	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Additional Notes or Comments

Changed course description, prereqs, exclusions, goals and topics to match university format.

Prepared by: Betty Lise Anderson