Department of Computer & Electrical Engineering & Computer Science
Florida Atlantic University
Course Syllabus

1. Course title/number, number of credit hours	
Control Systems 2 – EEL 5654	3 credit hours
2. Course prerequisites, corequisites, and where the course fits in the program of study	
Prerequisites: EEL 4652 Control Systems 1; Course is typically taken at the Senior year or at the graduate level in Electrical Engineering	
3. Course logistics	
Term: Fall 2011 This is a classroom lecture course ; It is offered live and via Distance Learning. *Class location and time*: T R 2:00-3:20 PM (Lecture) CM-128 This course has extensive design contents. Design is done theoretically and also via computer-aided tools utilizing Matlab software: Control Systems Toolbox and Simulink.	
4. Instructor contact information	
Instructor's name *Office address* *Office Hours* *Contact telephone number* *Email address*	Dr. Zvi Roth, Professor Engineering East (EE-96) Bldg., Room 519 M T W Th F: 3:30 – 4:30 PM 561-297-3471 rothz@fau.edu
5. TA contact information	
TA's name *Office address* *Office Hours* *Contact telephone number* *Email address*	**N/A**
6. Course description	
This is a second course in Control Systems covering more advanced topics from Digital Control, Nonlinear Systems and Control and Control Instrumentation.	
7. Course objectives/student learning outcomes/program outcomes	
Course objectives	1) Understanding how to implement controllers digitally 2) Understanding how to analyze and simulate control systems that suffer from nonlinearities 3) Learn about advanced nonlinear control design methods 4) Understanding more in-depth actuators (such as DC motors) and how to select them for a given application 5) Learn in more depth how to model complex control systems (such as aircrafts and robots), using Lagrange equations
Student learning outcomes & relationship to ABET a-k objectives	a) an ability to apply knowledge of mathematics, science and engineering - use of complex variables and complex functions, along with elements of functional analysis b) an ability to design and conduct experiments, as well as to analyze and

	interpret data – Finding transfer function model from measured time response and frequency response data c) an ability to design a system, component, or process to meet desired needs – Understanding how to interpret time domain and frequency domain design specifications and how to translate it to a feedback controller design d) an ability to function on multi-disciplinary teams – We expose electrical engineering students to control models taken from mechanical, aerospace and biomedical engineering. e) an ability to identify, formulate and solve engineering problems – Many of this course's design problems are open ended. f) an understanding of professional and ethical responsibility – N/A g) an ability to communicate effectively – students submit 6 Matlab/Simulink project. Emphasis is on written communication. h) broad education necessary to understand the impact of eng solutions in global and societal context – N/A i) a recognition of the need for and an ability to engage in lifelong learning – N/A j) a knowledge of contemporary issues – N/A k) ability to use the techniques, skills, and modern engineering tools necessary for engineering practice – use of Matlab and Simulink

8. Course evaluation method

Homework Simulation Projects (6) - 48% Midterm Exam 30% Final Examination - 30%	*Note*: The minimum grade required to pass the course is C.

9. Course grading scale

Grading Scale:
A= 90-100%, A-=85-89%, B+=80-84%, B=75-79%, B-=70-74%, C+=65-69%, C=60-64%, C-=55-59%, D+=50-54%, D=45-49%, D-=40-44%, F=0-39%.

10. Policy on makeup tests, late work, and incompletes

Makeup tests are given only if there is solid evidence of a medical or otherwise serious emergency that prevented the student of participating in the exam. Makeup exam should be administered and proctored by the College of Engineering Distance Education Office.

Late work is acceptable. Penalty points may be deducted depending how late the work is.

Incomplete grades are given only if there is solid evidence of medical or otherwise serious emergency situation incomplete grades will not be given.

11. Special course requirements

N/A

12. Classroom etiquette policy

University policy requires that in order to enhance and maintain a productive atmosphere for education,

personal communication devices, such as cellular phones and laptops, are generally to be disabled in class sessions.
Due to the design contents and the live design software demonstration, the use of laptop computers in class is allowed.

13. Disability policy statement

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) located in Boca Raton campus, SU 133 (561) 297-3880 and follow all OSD procedures.

14. Honor code policy

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and place high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. See University Regulation 4.001 at www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf

15. Required texts/reading

Katsuhiko Ogata, "Modern Control Engineering", Fifth Edition, Prentice Hall 2009.

16. Supplementary/recommended readings

N/A

17. Course topical outline, including dates for exams/quizzes, papers, completion of reading

Lecture 1: Course Syllabus; Review of basic concepts covered in Control Systems 1 – transfer functions, stability and transient response
Lecture 2: Review of basic concepts from Control Systems 1 – controller design techniques
Lecture 3: Controller digital implementation; The Z Transform and properties
Lecture 4: Digital Control basics: Stability in the Z plane, Sampling and Hold
Lecture 5: Digital Control: Discretizing of control processes; Simulation techniques using Simulink.
Homework 1 given (end of week 3)
Lecture 6: Nonlinear models; Classification of Equilibrium Points; Linearization.
Lecture 7: Modeling Piecewise Linear Nonlinear Systems; Servo models with saturation, backlash and dead-zone nonlinearities
Homework 2 is given (end of week 4)
Lecture 8: Simulation of nonlinear servo systems
Lecture 9: Sliding effects and basic Sliding Mode Control
Homework 1 is due.
Lecture 10: Advanced aspects of Sliding Mode Control
Homework 3 is given (end of Week 6)
Lecture 11: Nyquist Stability Theorem
Lecture 12: Examples of Nyquist plots; Matlab CST and Nyquist plots.
Homework 2 is due.
Lecture 13: Limit Cycles and the Describing Function method
Lecture 14: Advanced aspect of describing functions

Homework 4 given (end of week 8)
Homework 3 is due.
Lecture 15: DC motor and gear selection, Part 1
Midterm Exam (Week 9)
Lecture 16: Steady-State DC motor and gear selection, Part 2
Lecture 17: Modeling using Lagrange equations
Lecture 18: Robot manipulators modeling using Lagrange equations; Control of robots
Homework 5 is given (Week 11)
Lecture 19: Modeling of aircraft pitch angle control
Homework 4 is due
Lecture 20: Lyapunov Stability theory, Part 1
Lecture 21: Gain Lyapunov Stability theory, Part 2
Lecture 22: Lyapunov controller design
Homework 5 is due
Lecture 23: PID control: Ziegler-Nichols control tuning
Homework 6 is given (Week 13)
Lecture 24: PID control tuning in closed-loop
Lecture 25: PID control with real-time performance measurement
Lecture 26: Theory Phase-Locked Loops revisited: Pull-in and Lock-in range
Lecture 27: Case Study: Stability of power systems
Lecture 28: Review for the Final Exam
Homework 6 is due.
Final Exam (end of week 15)