Georgia Institute of Technology

System Dynamics - ME 3017

Spring 2018
Class: MWF 10:10 – 11:00 am, MRDC 2407

Instructor: Siavash Farzan sfarzan@gatech.edu

Graders:
Darren Maguire, (odd number PS) dmaguire3@gatech.edu
Catalina Nguyen, (even number PS) catalinanguyen@gatech.edu

Office Hours: Wednesdays and Fridays, 12-1 pm @ Clough Commons (CULC) 250

Course Description: ME 3017 System Dynamics (3-0-3)
Dynamic modeling and simulation of systems with mechanical, hydraulic, thermal, and/or electrical elements. Frequency response analysis, stability, and feedback control design of dynamic systems.

Prerequisites: ME 2016 Computing Techniques, ME 2202 Dynamics of Rigid Bodies, MATH 2403/2552 Differential Equations (C or better), and ECE 3710 Circuits and Electronics

References:
William J. Palm III, System Dynamics, 3rd Edition, McGraw-Hill Education, 2013.
Katsuhiko Ogata, System Dynamics, 4th Edition, Prentice-Hall, 2004.

Topics:
1. Laplace transforms
2. Modeling of mechanical systems
3. Transfer function models
4. Modeling of electrical and electromechanical systems
5. Modeling of fluid and thermal systems
6. Time response analysis of linear dynamic systems
7. Computer simulation of dynamic systems
8. Frequency response of linear dynamic systems
9. Free vibration of multi-degree of freedom systems
10. Input-output stability and transient response analysis
11. Introduction to feedback control systems

Grading Policy: Problem Sets (25%), Midterm 1 (20%), Midterm 2 (20%), Final (35%).

The following grades are guaranteed:

A: 90.0%+ B: 80.0%+ C: 70.0%+ D: 60.0%+ F: <60.0%

Problem Sets:
There will be one problem set roughly every second week, which will be posted to T-Square. The problem sets are due in class one week after assigned. Late submissions are not accepted.
Although you are encouraged to study together to learn the course material, the assignments and exams are expected to be completed *individually*.

Programming:
The objective with the programming assignments is to see how to bridge the gap between what is done in class and how to actually apply it. The assignments will be MATLAB-based.

Important Dates:

Midterm #1 ..... February 21, 2018 (in class)
Midterm #2 ..... April 2, 2018 (in class)
Final Exam ..... May 2, 2018 (8:00am - 10:50am)

Course Objectives and Outcomes:
Objective 1: To introduce students to mathematical modeling of dynamic systems in various engineering disciplines. Students will demonstrate:

1.1 Understanding of various mathematical models such as differential equation and transfer function models for dynamic systems.
1.2 The ability to formulate mathematical models for mechanical, electrical, fluid, and thermal systems.
1.3 The ability to model mixed systems such as electromechanical and hydro-mechanical systems.

Objective 2: To develop students skills in analyzing, simulating, and identifying dynamic systems based upon their input-output responses. Students will demonstrate:

2.1 That they can derive and analyze time response (transient & steady-state) of linear dynamic systems.
2.2 The ability to formulate the frequency response of linear dynamic systems.
2.3 Understanding of free vibrations of multi degree of freedom systems.
2.4 The ability to perform computer simulation of various dynamic system responses.
2.5 That they can apply time and frequency response analyses to system identification and design modification.

Objective 3: To introduce students to design and analysis of basic feedback control systems. Students will demonstrate:

3.1 Understanding of dynamic system stability and transient response specifications.
3.2 Understanding of block diagrams and how to reduce them.
3.3 The ability to design and analyze basic automatic controllers using algebraic techniques in the transfer domain.
3.4 The ability to apply feedback control to real-world engineering systems.

Academic Integrity:
Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit www.catalog.gatech.edu/policies/honor-code/ or www.catalog.gatech.edu/rules/18/.
Any student suspected of cheating or plagiarizing on a problem set, or exam, will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Access and Accommodations:
Your experience in this class is important to me. If you have already established accommodations with the Offices of Disability Services (disabilityservices.gatech.edu or dsinfo@gatech.edu), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.
Qualified students with special needs who will require accommodations (e.g., religious observances, disabilities, or GT sanctioned activity such as athletes travel) shall inform me as soon as possible (no later than the end of the second week of classes).

Tentative Schedule:

Monday	Wednesday	Friday
Jan 8th **1** Introduction to System Dynamics	10th **2** The Laplace Transform	12th **3** The Laplace Transform
15th *Martin Luther King Day*	17th **4** The Laplace Transform	19th **5** Laplace Trans. / Mechanical Sys.
22nd **6** Modeling of Mechanical Systems	24th **7** Modeling of Mechanical Systems	26th **8** Modeling of Mechanical Systems
29th **9** Modeling of Mechanical Systems	31st **10** Transfer functions	Feb 2nd **11** Transfer functions
5th **12** Transfer functions	7th **13** State-Space Approach	9th **14** State-Space Approach
12th **15** State-Space Approach	14th **16** Electrical&Electromechanical Sys.	16th **17** Electrical&Electromechanical Sys.
19th **18** Electrical&Electromechanical Sys.	21st **19** **Midterm 1**	23rd **20** Electrical&Electromechanical Sys.
26th **21** Electrical&Electromechanical Sys.	28th **22** Transient Response	Mar 2nd **23** Transient Response
5th **24** Transient Response	7th **25** Transient Response	9th **26** Transient / Frequency Analysis
12th **27** Frequency Domain Analysis	14th **28** Frequency Domain Analysis	16th **29** Frequency Domain Analysis
19th *Spring Break*	21st *Spring Break*	23rd *Spring Break*
26th **30** Frequency Domain Analysis	28th **31** Fluid and Thermal Systems	30th **32** Fluid and Thermal Systems
Apr 2nd **33** **Midterm 2**	4th **34** Curve fitting and Linearization	6th **35** Curve fitting and Linearization
9th **36** Stability Analysis	11th **37** Stability Analysis	13th **38** Stability / Feedback Control
16th **39** Feedback Control Systems	18th **40** Feedback Control Systems	20th **41** Feedback Control Systems
23rd **42** Final exam review	25th *Reading Period - No Class*	27th
30th	May 2nd **43** **Final Exam**	4th