

Department of Mechanical and Aerospace Engineering
The University Of Texas at Arlington
Classical Methods of Control Systems Analysis and Synthesis
ME 5303 - SPRING 2013

Instructor: Dr. P. S. Shiakolas

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Course Web Page: <http://mars.uta.edu/me5303> (check regularly for announcements)

Office Hours: TBA (strictly enforced) and by appointment

Prerequisites: Graduate Standing or Consent of Instructor, Introductory Modeling and Simulation

Text: *Modern Control Engineering* by K. Ogata, 5th or 4th Edition

Course Syllabus and Grading Policy

Homework (5): The purpose of the homework is to provide practice exercises that apply the theory and concepts presented in class in order to identify and improve on any deficiencies that might exist. It could be either analytical and/or computational. Late homework will not be accepted. Some homework solutions might be provided so it will be your responsibility to attempt, solve and understand the assigned homework, and this is the reason that it is only 5%. HW will be assigned based on 5th edition.

Semester Exam (25): There will be only one comprehensive mid-semester exam usually the week before spring break. It **may** consist of two parts (an analytical and a computational). Note that part or the whole exam may be take-home. Any in-class exam will be closed book-notes-electronic device. The distance learning students must make arrangements to take the exam at the same time as the on-campus students.

Final Exam (40): The final exam will be comprehensive and may consist of two parts; an analytical and a computational and will be closed book-notes. The exam will be given at the university scheduled time. Distance learning students must make arrangements to take the final at the same time as the on-campus students. If there will be a computational part, it could be given the last week of classes.

Makeup Exam: No makeup exams will be given unless I am notified in advance and approve of it. There will be only one comprehensive makeup exam the last week of the semester.

Attendance: It is your responsibility to attend the lectures, participate in the class discussion and be up to date with the course material. I do not and will not re-teach material covered in class during office hours.

Drop Policy: According to university regulations.

Guaranteed Grading Scale: The guaranteed grading scale based upon the minimum percentage number of points obtained is shown below. Note that no incomplete will be given unless prior arrangements are made and in extreme circumstances:

90% - 100%: A, 80% - 89%: B, 70% - 79%: C, 60% - 69%: D, 0 - 60%: F

Software: You may use any computer software that you like and there are many available such as SCILAB <http://www.scilab.org>, Mathematica <http://wolfram.com>, LabVIEW MathScript <http://www.ni.com>, Octave <http://www.octave.org>, MATLAB <http://www.mathworks.com>, Maple <http://www.mathsoft.com>, and many others. Make sure that you can have access to the software during the semester and you are proficient in it for the purposes of this class.

Remember that computer tools are there to help you to better understand certain concepts – **DO NOT** just learn how to exercise the software tools but make sure you understand the underlying concepts.

Additional Reference Material: Modeling, Simulation and Controls related books are available in the engineering library and software resources available on the internet – check also the class web page.

Miscellaneous: If you have a disability, any religious holidays that you need to observe or anything else that might interfere with this class and you would like for me to know about it you must inform me in writing no later than the third class meeting.

Course Web Page: Check it often for any resource notes or announcements.

Email Communication: Email communication will be to your official UTA issued email account and Blackboard utilities (<http://www.uta.edu/blackboard/>). It is your responsibility to check often.

The sciences do not try to explain, they hardly even try to interpret, they mainly make models. By a model is meant a mathematical construct which, with the addition of certain verbal interpretations, describes observed phenomena. The justification of such a mathematical construct is solely and precisely that is expected to work.

John Von Neumann

ME 5303 Tentative Topics (not in a particular order)

System Representation

- A. Differential Equations (Review)
- B. Transfer Functions (Review)
- C. Block Diagrams
- D. State Space (Review)

System Transient Response Analysis

- A. Pole, Zero Analysis
- B. Time Domain Response
 - Analytic (Review)
 - Numeric (Computational) - (Review)
- C. Frequency Domain Response
 - Frequency Response
 - Laplace Transform (Review)
- D. Stability

Feedback Control Systems

- A. Effects of Feedback Control
- B. Classical Control Action
 - Proportional (P), Integral (I) and Derivative (D)
 - Combinations PI, PD, PID
 - Analog implementation
- C. Error Analysis – Controller Design
 - Initial and Final Value Theorems
 - Static, Dynamic Error

- Performance Indices
- Controller Tuning

- D. Sensitivity Analysis

Controller Design (Pole-Zero locations)

- A. Root Locus Analysis
- B. Frequency Response Analysis
 - Bode Plot
- C. Compensation Analysis
 - Lead, Lag Compensation and combination

State Variable Feedback Systems

- A. Controllability and Observability
- B. Optimal Control

Introduction to Advanced Control Concepts (time permitting)

- A. Neural networks
- B. Fuzzy logic
- A. Estimation and Kalman filtering

Introduction to Digital Control Concepts (time permitting)

- A. z-Transform and Bilinear Approximation
- B. Sampling Rate
- C. Controller Implementation and Hardware Demonstrations

Americans with Disabilities Act

The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 93112-The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans with Disabilities Act – (ADA), pursuant to section 504 of The Rehabilitation Act, here is renewed focus on providing this population with the same opportunities enjoyed by all citizens. As a faculty member, I am required by law to provide "reasonable accommodation" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels.

Academic Dishonesty

It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspensions or expulsion from the University. "Scholastic dishonesty includes but is not limited to cheating, plagiarism collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts." (Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22)