

MAE 4310: Introduction to Automatic Control  
Spring 2017

**Instructor:** David Hullender

**Office Number:** Woolf Hall 304B

**Office Telephone Number:** (817)272-2014

**Email Address:** hullender@uta.edu

**Faculty Profile:** [www.uta.edu/profiles/david-hullender](http://www.uta.edu/profiles/david-hullender)

**Office Hours:** T-TH 9:30 am-11:00 am and by appointment

**Section Information:** MAE 4310-001

**Time and Place of Class Meetings:** Tues-Thurs 11:00-12:20, NH110

**Description of Course Content:** An initial objective of this course is to learn how the eigenvalues of a system affect the dynamic behavior of a system once the system experiences a disturbance from equilibrium or is given an input for the output of the system to track or follow. Also, an objective of this course is to learn feedback control techniques for improving the response characteristics of a system. MATLAB algorithms will be used for implementing control laws, solving equations and plotting the output solutions. Prior experience using MATLAB and SIMULINK will be useful but is not mandatory. Students inexperienced with MATLAB should consider this to be the introductory course as most of the solution methods will utilize existing MATLAB algorithms; the simplest way to learn how to use MATLAB is to study examples in this notebook and in the text, **Control System Engineering**, Norman S. Nise. Professor Hullender expects a student struggling with any aspect of MATLAB to get help from him; questions regarding the use of MATLAB will be included on exams. Key library reserve references are **Modeling and Simulation of Dynamic Systems**, Woods, Robert and Lawrence, Kent and **Modern Control Systems**, Dorf and Bishop and **Modern Control Engineering**, Ogata.

**Student Learning Outcomes:** This course is intended to provide a comprehensive treatment of the analysis and design techniques for achieving dynamic systems performance specifications.

**Required Textbooks and Other Course Materials:** **Control Systems Engineering** by Norman Nise, available at the UTA Bookstore

**Recommended additional materials:** **Student Ed. of Matlab** available to be downloaded on your laptop from the University; check with the 'help desk' for details. **"Review of Basic Math Principles, Special Topic Notes, and Previous Exams, January 2017 Edition"**, a notebook by Professor Hullender, available on Blackboard. A printed copy can be ordered and picked up at Bird's Copies, 208 S. East Street., Arlington, 817-459-1688

**Descriptions of major assignments and examinations** In-class examinations will be given; all exams are comprehensive. There are no make-up exams. Should absence from an exam be excused, the final average for the course will be based on one less exam. Unless stated otherwise, all exams are closed book and only a calculator provided by the test moderator is allowed. Key Assignments will be included as part of the exams; a passing grade on these key assignments is not mandatory.

**Attendance:** At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section Class and exam attendance is mandatory. Reasons for absence must be documented in writing to the instructor. Homework assignments will be included in computing the final grade; unless otherwise stated, all assignments are due at the beginning of the class

on the due date. Late homework submissions will not be accepted. Students are expected to do their own work.

However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients “begin attendance in a course.” UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

**Grading:** There will be 3 in-class exams (85%) and homework (15%). There will not be a final exam during final exam week. Letter grades at the end of the semester will be determined by the distribution of the averages of the students in the class. For example, in the case of several high averages, the distribution might be 93-100 for A, 83-92 for B, etc. If the highest averages are in the low 90's, then the distribution might be 86-94 for A, 76-85 for B, etc. Typically, it works out 90-100 for A, 80-89 for B, 70-79 for C, etc.

**Grade Grievances:** Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances **as published in the current undergraduate catalog.**

**Drop Policy:** Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/aao/fao/>).

**Disability Accommodations:** UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of **a letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

**The Office for Students with Disabilities, (OSD)** [www.uta.edu/disability](http://www.uta.edu/disability) or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability).

**Counseling and Psychological Services, (CAPS)** [www.uta.edu/caps/](http://www.uta.edu/caps/) or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

**Non-Discrimination Policy:** *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit [uta.edu/eos](http://uta.edu/eos).*

**Title IX Policy:** The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the

Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX) or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or [jmhood@uta.edu](mailto:jmhood@uta.edu).*

**Academic Integrity:** Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

*I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*

*I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>.

**Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

**Campus Carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

**Student Feedback Survey:** At the end of each term, students enrolled in face-to-face and online classes categorized as "lecture," "seminar," or "laboratory" are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback via the SFS database is aggregated with that of other students enrolled in the course. Students' anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:** for semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

**Emergency Exit Procedures:** Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, [which is located at the front of the room](#). When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

**Student Support Services:** UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to [resources@uta.edu](mailto:resources@uta.edu), or view the information at <http://www.uta.edu/universitycollege/resources/index.php>.

**The IDEAS Center (2<sup>nd</sup> Floor of Central Library)** offers **free** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email [IDEAS@uta.edu](mailto:IDEAS@uta.edu) or call (817) 272-6593.

**The English Writing Center (411LIBR):** The Writing Center Offers free tutoring in 20-, 40-, or 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Our hours are 9 am to 8 pm Mon.-Thurs., 9 am-3 pm Fri. and Noon-6 pm Sat. and Sun. Register and make appointments online at <http://uta.mywconline.com>. Classroom Visits, workshops, and specialized services for graduate students are also available. Please see [www.uta.edu/owl](http://www.uta.edu/owl) for detailed information on all our programs and services.

The Library's 2<sup>nd</sup> floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library's hours of operation. <http://library.uta.edu/academic-plaza>

**Teaching Assistant: To be determined**

**Course Schedule**  
**MAE 4310 Spring 2017**

Chapters, pages, and sections refer to *Control Systems Engineering*.

**Tentative Lecture/Topic Schedule**

|       |    |  |
|-------|----|--|
| Jan.  | 17 | Overview of course and control system examples, Chapter 1              |
|       | 19 | Review of basic mathematics and MATLAB techniques, pp 33-47 & Notebook |
|       | 24 | Review continued including linearization, pages 88-93 and Notebook     |
|       | 26 | Modeling in State Space, Chapter 3 and Notebook                        |
|       | 31 | Transformation of Math Models with MATLAB, Section 3.6 & Notebook      |
| Feb.  | 2  | Transient and Steady-state Response Analyses, Chapter 4 & Notebook     |
|       | 7  | Performance Index techniques for design optimization, Notebook         |
|       | 9  | ITAE Performance Index examples, ITAE eigenvalues, Notebook            |
|       | 14 | <b>Exam 1, comprehensive, closed book, no personal calculators</b>     |
|       | 16 | Steady state errors, Chapter 7   |
|       | 21 | Ralph's Stability Criterion, Chapter 6                                 |
|       | 23 | Block diagrams and SIMULINK, Section 5.1-5.4 and Appendix C            |
|       | 28 | Root-Locus Method, Chapter 8   |
| March | 2  | Root-Locus continued   |
|       | 7  | Additional root-locus design examples, Chapter 9                       |
|       | 9  | Design via State Space, Chapter 12                                     |
|       | 14 | Spring Break   |
|       | 16 | Spring Break   |
|       | 21 | Controllability and Observability, Sections 12.3-12.7                  |
|       | 23 | <b>Exam 2, comprehensive, closed book, no personal calculators</b>     |
|       | 28 | Linear quadratic regulator (MATLAB lqr) Notebook                       |
| April | 30 | Steady-state error design via integral control, Section 12.8           |
|       | 4  | Cont. Sys. Analysis and Design, Frequency-Response Method, Chap. 10    |
|       | 6  | Relative stability using the phase and gain margins, Section 10.7      |
|       | 11 | Design in the frequency domain, Chapter 11                             |
|       | 13 | Lead and lag controllers   |
|       | 18 | Lead and lag controllers continued                                     |
|       | 20 | PID controllers, Section 9.4 and 'help pidtune' in MATLAB              |
|       | 25 | Digital implementation of controllers, Chapter 13                      |
| May   | 27 | <b>Exam 3, comprehensive, closed book, no personal calculators</b>     |
|       | 3  | Class will not meet  |
|       | 5  | Class will not meet  |
|       |    | No final exam; first three exams were comprehensive                    |

**Emergency Phone Numbers:** In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381

## **Library Home Page [library.uta.edu](http://library.uta.edu)**

### **Resources for Students**

#### **Academic Help**

Academic Plaza Consultation Services [library.uta.edu/academic-plaza](http://library.uta.edu/academic-plaza)

Ask Us [ask.uta.edu/](http://ask.uta.edu/)

Library Tutorials [library.uta.edu/how-to](http://library.uta.edu/how-to)

Subject and Course Research Guides [libguides.uta.edu](http://libguides.uta.edu)

Subject Librarians [library.uta.edu/subject-librarians](http://library.uta.edu/subject-librarians)

#### **Resources**

A to Z List of Library Databases [libguides.uta.edu/az.php](http://libguides.uta.edu/az.php)

Course Reserves [pulse.uta.edu/vwebv/enterCourseReserve.do](http://pulse.uta.edu/vwebv/enterCourseReserve.do)

FabLab [fablab.uta.edu/](http://fablab.uta.edu/)

Special Collections [library.uta.edu/special-collections](http://library.uta.edu/special-collections)

Study Room Reservations [openroom.uta.edu/](http://openroom.uta.edu/)

### **Teaching & Learning Services for Faculty**

Copyright Consultation [library-sc@listserv.uta.edu](mailto:library-sc@listserv.uta.edu)

Course Research Guide Development, Andy Herzog [amherzog@uta.edu](mailto:amherzog@uta.edu) or your subject librarian

Data Visualization Instruction, Peace Ossom-Williamson [peace@uta.edu](mailto:peace@uta.edu)

Digital Humanities Instruction, Rafia Mirza [rafia@uta.edu](mailto:rafia@uta.edu)

Graduate Student Research Skills Instruction, Andy Herzog [amherzog@uta.edu](mailto:amherzog@uta.edu) or your subject librarian

Project or Problem-Based Instruction, Gretchen Trkay [gtrkay@uta.edu](mailto:gtrkay@uta.edu)

Undergraduate Research Skills Instruction, Gretchen Trkay [gtrkay@uta.edu](mailto:gtrkay@uta.edu) or your subject librarian.