# 01/14/2019

Instructor: Dr. B. Robert Mullins, Jr., P.E. Office Number: Woolf Hall, Rm #302 Office Telephone Number: 817-272-2896 Email Address: mullins@uta.edu Faculty Profile: <u>https://mentis.uta.edu/explore/profile/baxter-mullins</u> Office Hours: MTWT 4:00 – 5:00 PM (other times by appointment) Section Information: AE 5303-001/002, ME 5303-001/002 Time and Place of Class Meetings: MoWe 5:30PM – 6:50PM, NH Rm #105

# **Description of Course Structure**

This course is structured to provide the student the necessary fundamentals for solving engineering problems with an "industrial perspective" of the material and its use in that environment. The instructor will be your "customer/client/manager" and you, the student, are the "engineer" providing the requested analysis and presentation of the results in an organized manner based on standard practices and processes. The intent is to prepare the student to quickly perform at a high level in industry upon graduation. To that end, there are very specific processes to be followed and an expected quality of work products.

## **Description of Course Content**

**AE/ME 5303. CLASSICAL METHODS OF CONTROL SYSTEMS ANALYSIS AND SYNTHESIS.** Equip the student with familiarity of significant tools of the control engineer. Topics covered include controllers and their effect on system performance and stability, block diagram algebra, stability and analysis, system performance definition, root locus, frequency techniques, and state variable methods. Digital simulation tools for design and simulation of control systems. Demonstration of controller design and performance in the laboratory. Also offered as AE 5303 and ME 5303. Credit will be granted only once.

#### **Student Learning Outcomes**

With the successful completion of this course, the student shall have a basic understanding of how to develop and model physical systems, analyze system behavior, and develop simplified control techniques, and the short falls of such models, including basic understanding of analysis techniques commonly used. As this is a professional-level course, the instructor shall be concerned with the student's response in meeting class requirements in a responsible, professional manner, considering both schedule and presentation. As such, industrial practices shall be included as part of the classroom, homework, and project activities with standard nomenclature and processes introduced and practiced. This shall include standard industrial practices developed by national and international agencies including ISO, Six Sigma, government (e.g., FARS, MIL STD) and professional organizations (e.g. ASME, AIAA, SAE, AHS, etc.).

# Descriptions of major assignments and examinations

Exams:

Two (2) exams (approximately the 6<sup>th</sup> and 11<sup>th</sup> week of course), and a final exam (May 8, 2019, 5:30 – 8p.m.).

# Assignments:

- Assignments will be made throughout the semester.
- Assignments <u>must</u> follow the format provided on Blackboard and include a (1) Problem Statement (Statement of Work) with appropriate sketches, (2) Problem "Knowns", (3) Problem Requirements, (4) Solution Approach, (5) Solution with equations, references and all necessary work to completely describe the solution, and (6) Answers will be Boxed. Computer programs, output, graphs, etc. will be attached to the solution. The top of each page of the assignment will have your Last Name, First Name, Class Information, and Date Due. Complete format requirements with examples can be found

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on Blackboard. When evaluated/graded, failure to follow the format will result in a "zero" grade for that assignment.

- Project format will be provided on Blackboard.
- Assignments shall be presented on engineering paper using the front-side of the paper only.
- Each assignment will be scanned as single pdf file and uploaded to Blackboard by the date and time as instructed by the instructor. Failure to follow the directions will result in a "zero" grade for that assignment.

## ME 5303 Tentative Topics (not in a particular order)

## **System Representation**

A. Differential Equations

- B. Transfer Functions
- C. Block Diagrams
- D. State Space Linearization

## System Transient Response Analysis

A. Time Domain Response

- B. Frequency Domain Response
- C. Stability

## **Feedback Control Systems**

- A. Effects of Feedback Control
- B. Classical Control Actions (P, I, D)
- C. Error Analysis Controller Design
- D. Sensitivity Analysis

# **Controller Design (Pole-Zero locations)**

- A. Root Locus Analysis
- B. Frequency Response Bode Plot
- C. Compensation Analysis Lead & Lag
- D. Analog Controller Design/Representation

# Every day "Rules-of-Thumb," will be presented and discussed throughout the semester.

Theory formulation, variable definition, analysis procedure and results presentation will follow industry standards. This shall include standard industrial practices developed by national and international agencies including ISO, Six Sigma, government (e.g., FARS, MIL STD) and professional organizations (e.g., ASME, AIAA, SAE, AHS, etc.).

Prerequisites: Graduate Standing or Permission of the Instructor

#### **Required Textbooks and Other Course Materials**

- Nise, Norman S., *Control Systems Engineering*, 7<sup>th</sup> ed., John Wiley & Sons, Inc., 2015\*.
- 12" ruler, protractor, and compass are required.
- Engineering Paper or Quad-Ruled Paper

**Software:** You may use any computer software that you like and there are a many available such as

# State Variable Feedback Systems

- A. Controllability and Observability
- **B.** Estimation
- C. Optimal Control
- D. Controller Design

# Introduction to Advanced Control Concepts (time permitting)

- A. Neural networks
- B. Fuzzy logic

# Introduction to Digital Control Concepts (time permitting)

- A. z-Transform and Bilinear Approximation
- B. Controller Implementation and Hardware Discussions

SCILAB http://www.scilab.org, Mathematica http://www.wolfram.com, LabVIEW http://www.ni.com, MATLAB/SIMULINK http://www.mathworks.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. Instructor will primarily use CC5.

## References

- Ogata, K., *Modern Control Engineering*, 5<sup>th</sup> ed., Pearson, 2010.
- Dorf, Richard C., and Bishop, Robert C., *Modern Control Systems, 13<sup>th</sup> ed.*, Pearson, 2016.
- Distefano, J., et al., *Schaum's Outline of Feedback and Control Systems, 2nd ed.* (Schaum's Outline Series), McGraw-Hill, 2013.
- Frederick, D.K., and Chow, J., *Feedback Control Using MATLAB and the Control System Toolbox* (Bookware Companion Series), Cengage Learning, 1999.
- Zill, Dennis G., *Advanced Engineering Mathemati*cs, Jones and Bartlett Publishing, MA 2009 (Chap 4 The Laplace Transform, Chap 10 Systems of Differential Equations, Chap17 Complex Numbers)
- Bretscher, Otto, *Linear Algebra with Application, 5th ed.*, Pearson, Boston, 2013.

## Additional Information

- Class lectures will be taped for review by off campus students and not available to on campus students.
- Exams for off campus students will be provided to designated administrator at your work location. The administrator will act as a monitor for the exam and will package and return exam to UTA in a timely manner. If an administrator/monitor is not available at the students work location, the student must take the exam on campus at the designated place and time.
- Off campus students shall take the Final Exam on campus at the designated place and time.

**Assignments & Projects** - Graphs/plots shall follow standard engineering formats. Chart Titles, Axis Titles, Legends, Scales and increment values, Grids and Tick marks, Descriptive textbox with pertinent information, etc. Failure to follow all the guidelines will result in a "zero" for item. An example of an engineering graph with annotations is provided on Blackboard.

**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. Students are expected to attend every class, to arrive on time, and to stay in class <u>until they are dismissed</u>. Students who fail to adhere to the attendance policy can expect an impact on their grade.

#### Grading

•	First Trimester Exam:	25%
•	Second Trimester Exam:	25%
•	Final Exam:	30%
•	Assignments:	20%

Grade Allocation: Letter grades will be assigned by the following ranges
 A (85-100), B (75-84), C (65-74), D (55-64), F (less than 55)

Note that no incomplete grade will be given unless prior arrangements are made and in extreme circumstances.

As grades are assessed, they will be posted on Blackboard for the students to review. Students are expected to track of their performance throughout the semester and seek guidance from available sources beginning with your instructor and GTA if their performance drops below satisfactory levels. The instructor and GTA will be available to assist all students during regular office hours or by appointment.

**Homework (5-point basis):** 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. Not all HW problems will be graded. It is your responsibility to attempt, solve and understand the assigned homework. Late homework will not be accepted.

# Descriptions of major assignments and examinations

- Assignments will be made throughout the semester.
- Assignments <u>must</u> follow the format provided on Blackboard and include a (1) Problem Statement (Statement of Work) with appropriate sketches, (2) Problem "Knowns", (3) Problem Requirements, (4) Solution Approach, (5) Solution with equations, references and all necessary work to completely describe the solution, and (6) Answers will be Boxed. Computer programs, output, graphs, etc. will be attached to the solution. The top of each page of the assignment will have your Last Name, First Name, Class Information, and Date Due. Complete format requirements with examples can be found on Blackboard. When evaluated/graded, failure to follow the format will result in a "zero" grade for that assignment.
- Project format will be provided on Blackboard.
- Assignments shall be presented on engineering or quad-ruled paper using the front-side of the paper only.
- Each assignment will be scanned as single pdf file and uploaded to Blackboard by the date and time as instructed by the instructor. Failure to follow the directions will result in a "zero" grade for that assignment.

**Semester Exams:** There will be two comprehensive exams given during the semester. They may consist of two parts (an analytical and a computational). Note that part or the whole exam may be take-home. Any inclass exam will be closed book-notes-electronic device. The distance learning students must make arrangements to take the exam at the same time or day as the on-campus students.

**Final Exam:** The final exam will be comprehensive and may consist of two parts; an analytical and a computational and will be closed book-notes-electronic device. The exam will be given at the university scheduled time. Distance learning students must make arrangements to take the final at the same time or day 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.

# **Special Needs**

The instructor <u>must</u> be notified at the beginning of the semester, **within the first week of class**, by any student requiring **'Special Needs'** exam testing. The student must be registered and approved for special testing allowances. If so, the student is responsible for obtaining and presenting the necessary confirmation forms to the instructor in that first week. Additionally, **the student is responsible for coordinating all "special needs testing" with the test center <u>two weeks before each exam</u>. This includes coordinating with the instructor the date and time of the alternate test. Per the university procedures, the testing center will** 

contact the instructor and arrange the necessary private test schedule after the student has coordinated with the test center and the instructor. Failure to meet these requirements will negate any "special needs testing" for that exam.

#### **Course Schedule**

Spring session begin on January 14, 2018, and ending on May 3, 2019, with final exams held from May 6<sup>th</sup> through May  $10^{rd}$  2019. Spring break is schedule for March 11 - 16, 2018. A class schedule will be provided on Blackboard. Exam dates and reading assignments are provided. Homework, assignments and project assignments will be updated on a continuous basis. As directed by the instructor, homework, assignments and projects shall be scanned as a pdf and uploaded to Blackboard otherwise the will be handed in at the beginning of class. Homework not handed in before the beginning of class will be considered late and given a grade of zero.

#### **Use of Electronic Devices**

- Cellphone use in class is prohibited. They must be turned off and stored during class.
- No internet capable devices (i.e. laptops, tablet devices or calculators) can be used during exams.
- Only simple, hand calculators (non-smart devices) are permitted during class exams.
- Laptops, tablet devices, etc. (but no cellphones) may be used during lectures for taking personal notes with <u>written permission</u> of the instructor. Any other use of electronic devices will nullify any agreement allowing personal note taking on such devices.
- No audio and/or video recordings by the students are permitted.
- All audio devices such as headphones, earbuds, etc., must be turned off and stored during class time.

#### **Expectations for Out-of-Class Study**

Beyond the time required to attend each class meeting, students enrolled AE/ME 5303-00X, a 3-credit hour course, should expect to spend at least an additional <u>9 hours per week</u> of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc. (The general rule of thumb is for every credit hour earned, a student should expect to spend at minimum 3 hours per week working outside of class.)

#### **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. For undergraduate courses, see <a href="http://catalog.uta.edu/academicregulations/grades/#undergraduatetext">http://catalog.uta.edu/academicregulations/grades/#undergraduatetext</a>; for graduate courses, see <a href="http://catalog.uta.edu/academicregulations/grades/#graduatetext">http://catalog.uta.edu/academicregulations/grades/#undergraduatetext</a>; for graduate courses, see <a href="http://catalog.uta.edu/academicregulations/grades/#graduatetext">http://catalog.uta.edu/academicregulations/grades/#graduatetext</a>; For student courses, see <a href="http://catalog.uta.edu/academicregulations/grades/#graduatetext">http://catalog.uta.edu/academicregulations/grades/#graduatetext</a>. For student complaints, see <a href="http://www.uta.edu/deanofstudents/student-complaints/index.php">http://www.uta.edu/deanofstudents/student-complaints/index.php</a>.

#### **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://wweb.uta.edu/ses/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 (ADAA),* 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 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.

<u>Counseling and Psychological Services, (CAPS)</u> 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.

**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 or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or 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 as they see fit in their courses, including (but not limited to) 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.

#### Lab Safety Training

No lab training is required for this course.

**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 <a href="http://www.uta.edu/oit/cs/email/mavmail.php">http://www.uta.edu/oit/cs/email/mavmail.php</a>.

**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 <u>http://www.uta.edu/news/info/campus-carry/</u>

#### **Student Feedback Survey**

At the end of each term, students enrolled in classes categorized as "lecture," "seminar," or "laboratory" shall be 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 enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <a href="http://www.uta.edu/sfs">http://www.uta.edu/sfs</a>.

**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.

**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 <u>tutoring</u>, <u>major-based learning centers</u>, developmental education, <u>advising and mentoring</u>, personal counseling, and <u>federally funded programs</u>. 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 <u>resources@uta.edu</u>, or view the information at <u>http://www.uta.edu/universitycollege/resources/index.php</u>.

The IDEAS Center (2nd 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 or call (817) 272-6593.

The English Writing Center (411LIBR): The Writing Center Offers free tutoring in 20-, 40-, or 60-minute faceto-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 <u>http://uta.mywconline.com</u>. Classroom Visits, workshops, and specialized services for graduate students are also available. Please see <u>www.uta.edu/owl</u> 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. <u>http://library.uta.edu/academic-plaza</u>

#### Library Home Page library.uta.edu

#### **Resources for Students**

#### Academic Help

- Academic Plaza Consultation Services library.uta.edu/academic-plaza
- Ask Us ask.uta.edu/
- Library Tutorials library.uta.edu/how-to
- Subject and Course Research Guides libguides.uta.edu
- Subject Librarians library.uta.edu/subject-librarians

#### Resources

- A to Z List of Library Databases libguides.uta.edu/az.php
- Course Reserves <u>pulse.uta.edu/vwebv/enterCourseReserve.do</u>
- FabLab <u>fablab.uta.edu</u>
- Special Collections <u>library.uta.edu/special-collections</u>
- Study Room Reservations <u>openroom.uta.edu</u>

#### Notice

# The instructors reserve the right to make changes to the course syllabus as necessary. It is the student's responsibility to keep up with changes to the syllabus as posted on the class website.

#### COPYRIGHT

Copyright<sup>(C)</sup> 2019 UTA COE as to this syllabus, all lectures, and all course materials. Students are prohibited from selling; notes taken during this course, provided course materials, or provided software. Students are also prohibited from being paid by any person or commercial firm for these materials without the express written permission of the professor teaching this course.

AE/ME 5303-00X Classical Methods of Control Systems Analysis and Synthesis Spring Semester 2019 B. Robert. Mullins, Jr. • Room 302WH • Tel: 817-272-2896 • E-Mail: *mullins@uta.edu* 

# AE/ME 5303-00X Classical Methods of Control Systems Analysis and Synthesis

## **3 HOURS CREDIT**

## SPRING 2019

## **S**YLLABUS

By signing this document, the student acknowledges that he/she has read and understood the syllabus for AE/ME 5303-00x. This document is due January 21, 2019.

Print Name: \_\_\_\_\_

Student ID: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Prepared by:B. Robert Mullins, Jr.Date:14 January 2019