ME 386M: Modeling, Simulation, and Control of Physical Systems
Fall 2020, Unique No. 18330

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1. Course rationale: This course is meant to provide a graduate level review and/or introduction to dynamic system modeling and the use of simulation for mechanical engineering professionals. Mechanical engineers should understand how mechanical, thermo-fluid, electrical and electromechanical systems interact within machines and processes. Basic concepts and methods can be learned from simple examples, but an emphasis is given on practical engineering systems with a wide range of complexity and across many disciplines. A bond graph method is introduced to help formalize the development of mathematical models and to guide analysis and computational study. The course is meant to enhance the engineer's ability to *see* how physical systems are put together and how they can be mathematically and computationally modeled to understand their behavior and guide design or to help describe failure.

2. Course aims / objectives: The course will provide an in depth review of how to model engineering systems that include mechanical translation and rotation, fluid, thermal, electrical, and electromechanical systems. The intent is to build insight and confidence in developing mathematical models to study both time and frequency response, and how to use these models to specify and design system behavior. The course will build skill in the use of nonlinear simulation and linear analysis tools in Matlab.

3. Format and procedures: This is an online course delivered using the UT Canvas course management system with password-protected access at http://canvas.utexas.edu. The course contains eight (8) modules with each module containing multiple related lessons. A *course log* (or 'clog') will appear on the course home page to convey actual class progress. The Canvas course page is used to distribute all course materials, to communicate and collaborate online, to post grades, to submit assignments, and to give you online quizzes and surveys. You can find support using the online Canvas Help.

4. Course Schedule: This syllabus represents current plans and objectives. As we go through the semester, it may be discovered that more or less time is required to cover certain topics, and adjustments may be made. Certain case studies may also require more time. Given these expected changes, the exact dates for quizzes and exams will be scheduled once the semester begins, with sufficient time given for preparation. Refer to the Canvas course page and *course log*. See Table 1 for tentative schedule of major topics and assignments.

5. My assumptions: It is assume you have some knowledge of mechanical engineering and have studied dynamics, fluid mechanics, thermodynamics, and electrical and magnetic concepts. In addition, it is expected that you have had a course in differential equations, have knowledge of linear algebra, and have familiarity with computer programming, preferably with use of the Matlab program. I assume you are prepared to engage in this course in a manner that is expected of a graduate level engineering student at UT-Austin, meaning you should be resourceful and engaged in your learning.

Table 1: Tentative schedule of topics and assignments

Week(s)	Topics(s)	Homework / Case studies
1-2	Introduction	HW 1A,1B
2-3	Kirchhoff systems	HW 2A,2B
3-4	Simulation concepts	HW 2C
5-7	Bond graph methods	HW 3A,3B
8-10	Model formulation and evaluation	HW 4A,4B
10-11	Linear system analysis	HW 5A,5B
12	Transfer functions and frequency response	HW 6
13-14	Final case study and review	Case study 3

6. Course Requirements and Policies:

Course progress and participation policy:
(a) **Progress**: You may be working full time and are taking this course to supplement your knowledge and advance your career, and I expect there may be times that your job does cause delays in progress. However, this is not a self-paced course and I assume you are prepared to catch up as soon as possible. I am willing to work with you in a manner that is fair to all those enrolled in the course. Please keep the lines of communication open, as we would like to see you succeed in this program.
(b) **Participation**: Your participation in online discussions, interactions with the instructor and TA, and contributing to case studies can make this course useful to you and to others enrolled. A small part of your grade will be based on these efforts.
(c) **Behavior**: Civility statement and code of conduct - you are expected to show respect and civility in all discourse with the TA, fellow students, administrators, and the course instructor.

Course Readings/Materials:
(a) **Textbook**: Course notes and lecture slides will be provided on the course Canvas site. Given the breadth of topic areas covered selected handouts may also be provided.
(b) **Supplemental references**: In addition to the course notes, you may consider obtaining a copy of a book on system dynamics. Good examples are: D. Rowell and D.N. Wormley, System Dynamics (Prentice-Hall, 1997), C.M. Close, D.K. Frederick, J.C. Newell, Modeling and Analysis of Dynamic Systems (Wiley). If you want a published book that discusses bond graphs, seek out any edition of System Dynamics, D. Karnopp, D. Margolis, and R. Rosenberg (Wiley-Interscience). Other references will be indicated on particular topics throughout the course.
(e) **Matlab Usage and Access**: Familiarity with the Matlab programming environment is expected but can also be gained through the Lynda.com course "Up and Running with Matlab". Note that Lynda.com courses are freely available for students in the UT MS program. It is expected that you will seek out ways to gain access to Matlab through the site-license available to UT-Austin (http://www.engr.utexas.edu/itg/products/8017-matlab-). A new feature from MathWorks provides access to Matlab via a web browser.

Assignments, Assessment, and Evaluation:
(a) **Assignments**: All homework assignments and case studies are assigned on Canvas with specified due dates and submission requirements. Unless otherwise indicated, these should be submitted as PDF documents via Canvas.
(b) **Preparation**: it is expected that all submitted work will be prepared in a professional, legible manner. The instructor and TA will request resubmission of any work that does not meet our standards. These resubmissions will be subject to the late policy.
(c) **Late policy**: Three late homework submissions will be allowed as follows without penalty: 1 day

late (2), 2 day late (1). Any other late submission will be penalized at 20% each day.
(d) **Make-ups**: Any make-ups on quizzes or exams will be handled on a case by case basis however please give *prior* notice if possible.
(e) **Grading style**: All grading will be completed online by the instructor and TA, with feedback indicated directly on the submitted PDF documents.
(f) **Quizzes**: Dates for quizzes: to be posted on Canvas course site schedule
(g) **Final exam**: Date and time of Final Exam will: to be posted on Canvas course site schedule

7. Grading Policy: Homework (30%), Participation (5%), Case studies (25%), Quizzes (15%), Final Exam (25%).

8. Academic Integrity: University of Texas Honor Code - The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

Each student in this course is expected to abide by the University of Texas Honor Code. Any work submitted by a student in this course for academic credit will be the student's own work. For this course, collaboration is allowed when specified in the assignment.

9. Other University Notices and Policies: Be familiar with the University's official e-mail student notification policy. It is your responsibility to keep the University informed of changes in e-mail address. Students are expected to check Canvas and e-mail on a frequent and regular basis in order to stay current with University-related communications, recognizing that certain communications may be time-critical. (see http://www.utexas.edu/its/help/utmail/1564).

Documented Disability Statement. The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD. Notify the course instructor or TA as quickly as possible if the material being presented in class is not accessible (e.g., instructional videos need captioning, course slides are not readable, etc.).

Behavior Concerns Advice Line (BCAL). If you are worried about someone's behavior, use the Behavior Concerns Advice Line to discuss your concerns. This service is provided through a partnership among the Office of the Dean of Students, the Counseling and Mental Health Center (CMHC), the Employee Assistance Program (EAP), and The University of Texas Police Department (UTPD). Call 512-232-5050 or visit http://www.utexas.edu/safety/bcal.

Religious Holy Days: University policy requires students to notify their instructors as far in advance of the absence as possible so that arrangements can be made. You will be given an opportunity to complete missed work within a reasonable time after the absence.

Drop Policy. Contact the program administration about drop policy.