1. **MEE322 – Dynamic Systems and Control I**

   Fall 2018

   Course (catalog) description

   Modeling of engineering systems, linearization, transfer functions, feedback, PID control, Root-locus and introduction to Bode design. In addition to lecture, the course has scheduled laboratory sessions.

   Course objectives On completing this course, the student will be able to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Specifically, the student will be able to:

   - Develop a design strategy based on project and client needs and constraint
   - Think holistically: sees the whole as well as the parts
   - Support design procedure considering design options and iterations with documentation and references
   - Consider all the relevant technical, nontechnical or external factors and design tradeoffs

2. **Prerequisites:** MEE 321 and ELE 210.

3. **Credit and contact hours:** 3 Cr. hrs.

   Meeting times
   Tue, Thu 8:00a–9:15p EB 241

   Laboratory times
   Refer to schedule and myniu, EB 259

4. **Instructor:** Sachit Butail

   EB 148
   Office hours: Tue, Thu 12:30p–2:00p or by appointment
   sbutail@niu.edu
   (815) 753-9987

5. **Teaching assistants:** Hari Boddeeti (HB)

   EB 253 (HB)
   Office hours: Mon, Wed 3:00–5:00p
   Z1817537@students.niu.edu (HB)

6. **Textbook(s) and/or other required materials:**

   We will closely follow the online version of the textbook and control tutorials below:

   (AM) Feedback Systems: An Introduction for Scientists and Engineers
   Karl J. Åström and Richard M. Murray
   Publisher: Princeton University Press
   Available online at `http://www.cds.caltech.edu/~murray/amwiki/Main_Page`

   (CTM) Control Tutorials for MATLAB and Simulink `http://ctms.engin.umich.edu/CTMS`

7. **Specific Course Information:**

   i. **Homeworks:**
   Homeworks will be assigned at the end of almost every week and will be due in the following week (Tuesday or Thursday depending on how long it may be). You may collaborate on these, however, the work you submit should be entirely your own. **Late submissions will not be accepted.**

   ii. **Quiz/Exams:**
   In-class quiz will be given almost every week, which will be reviewed shortly thereafter. The quiz will be closed book, closed notes. Three exams including the final exam will be given during the course of the semester. The exams will be cumulative focusing on all the material covered until the week before the exam.

   iii. **Lab:** We will have three lab sessions in this course. You have already selected your lab day (Mon, Tue, Wed, or Thu) when you registered for this course. See planned dates on the schedule below.

   iv. **Grading:**
   - Homework Assignments: 10%
   - Quiz: 10%
   - Labs (3): 10%
   - Exams (3): 45%
   - Projects (2): 25%

   v. **Note:**
   - Students who are enrolled in the honors section are expected to complete a group project that will count towards 20% of their grade. Please contact me as soon as possible to get started.
   - It is your responsibility to check your scores on Blackboard periodically. Scores will only be updated for the most recent homework/quiz/project/exam.

8. **Topics covered:** We will try to interleave topics as that has been shown to aid in long-term retention and learning[1]:

   (a) Introduction: what is feedback, forms of feedback, examples
   (b) System Modeling: modeling concepts, state space form, examples
   (c) Examples of cruise control, inverted pendulum, DC motor
   (d) Transfer Functions: frequency domain modeling, gain poles and zeros, block diagrams
   (e) PID Control: basic functions, tuning, implementation
   (f) Frequency Domain Design: feedforward, feedback design principles, root-locus, examples

[1] Brown, P. C., Roediger III, H. L., & McDaniel, M. A. (2014). Make it stick. Harvard University Press.

Tentative Schedule

Wk	Tue	Thu	Outcome	Recommended Reading
1	28-Aug	30-Aug	Feedback and some applications	AM1.1-1.5
2	4-Sep	6-Sep	System modeling. Motor speed, Motor Position, Cruise control	AM1.6-1.9, Matlab basics
3	11-Sep	13-Sep	System representation. MATLAB	AM2.1 (pg 1-6), AM 3.2
4	18-Sep	20-Sep	Block diagrams. Simulink	AM2.1 (pg 7-9), Simulink basics
5	25-Sep	**27-Sep**	Interchange	
6	2-Oct	4-Oct	System identification	CTM > Index > Extras > System Identification
7	9-Oct	11-Oct	PID. Cruise control and other examples	AM11.1, PID
8	16-Oct	18-Oct	PID Tuning	AM11.2, AM11.3
9	23-Oct	25-Oct	Root locus	AM11.2, AM11.3
10	30-Oct	**1-Nov**	Control system design by Root locus	AM12.4
11	6-Nov	8-Nov	Inverted pendulum	CTM > Inverted Pendulum > PID
12	13-Nov	15-Nov	Ball and beam	
13	20-Nov		Aircraft pitch control	
14	27-Nov	29-Nov	Aircraft pitch control	
15	4-Dec	6-Dec	Open	
		13-Dec		

Legend
Laboratory this week
Exam on this day

Accessibility Statement

If you need an accommodation for this class, please contact the Disability Resource Center as soon as possible. The DRC coordinates accommodations for students with disabilities. It is located on the 4th floor of the Health Services Building, and can be reached at 815-753-1303 (V) or drc@niu.edu. Also, please contact me privately as soon as possible so we can discuss your accommodations. The sooner you let us know your needs, the sooner we can assist you in achieving your learning goals in this course.

Academic Integrity

Please carefully go through `http://www.niu.edu/ai/students/`. Please discuss with me if you have doubts about what constitutes dishonesty, plagiarism, and cheating. You are responsible for your work!