**Syllabus**
**MEEG 311 – Vibrations and Control – Fall 2019**

**Lecture:**

Lectures: TuTh 11:00–12:15pm, Gore 104
Discussion: We 4:40–6:30pm, Brown Lab 205

**Instructor:** (for section 011) Bert Tanner

Office: SPL 228
Phone: 831-6888
Email: btanner@udel.edu
Office Hours: Wed 1:00pm-3:00pm

**Teaching assistants:**

| **Graduate** | | **Undergraduate** | |
|---|---|---|---|
| | Chuchu Chen | Discussion | TBD |
| Office hours: | TBD | Discussion | TBD |
| Email: | chuchu@udel.edu | Lab | TBD |

**Prerequisites Information:** MEEG211 or CIEG311.

**Text:** Franklin, Powell, and Emami-Naeini. *Feedback Control of Dynamic Systems,* Pearson, 8th edition, 2019.

Additional course material, announcements, and assignment grades will be available electronically through Canvas.

**Description:** This is a **required** undergraduate mechanical engineering curriculum course. The course requires students to *apply principles of engineering, basic science, and mathematics (particularly differential equations), to analyze and design control systems.* The course contains elements of vibration analysis, and is focused on analysis and control design for single-input-single-output (SISO) dynamical systems expressed by linear differential equations with constant coefficients. The course introduces the concepts of damping & resonance, reviews the behavior of first- and second-order systems, and moves on to modification of this behavior using feedback control design. Topics include stability, steady state and transient performance, analysis tools such as the root locus and the Bode diagram.

**Basic Outcomes:** At the end of the course, students should be able to design a basic PID controller.

Specific topics coverage plan:

- Basic concepts
- Laplace transforms and transfer functions
- Mathematical models of of mechanical, electrical, fluid, and thermal systems
- Block diagrams
- Linearization
- DC motor modeling and analysis
- Transient response analysis
- Steady state response analysis
- Feedback analysis
- Stability analysis – Ruth's criterion
- Root locus
- Bode diagrams – construction & analysis
- Gain/phase margins, crossover frequency, bandwidth
- PID design and compensation

**Evaluation methods:**

- Quizes (10%): most modules are linked to a few minutes (timed) quiz aimed at testing the understanding of basic concepts. The completion of these quizes is a prerequisite for a student accessing later modules.

- Project (30%): A semester-long project requires the application of the knowledge acquired throughout the course on a concrete example system. The project is organized in several phases, synched with the introduction of the lecture material necessary for the completion of the required task in each phase. Completion of each phase is demonstrated with the electronic submission (through Canvas) of a document/report, which is understood to become a chapter in the final report detailing the student's project activities. Students can partially recover points lost in previous submissions by revising and resubmitting past assignments based on instructor feedback.

- Problems (0%): Although not contributing to the final grade, a mention on homework problems is necessary. A portion of the course's modules are associated with *recommended* practice problems from the textbook. It is expected that students try

these problems on their own as part of their necessary review and study of the lecture material, and if they have problems completing these assignments they should seek help from the instructor or the TAs. Without the submission requirement students have the freedom of studying these problems at their own pace. In any case, it is strongly recommended that they do so, since these suggested problems are essentially their study guide for the exams which will have very similar format.

- Midterm exam (30%): There will be one midterm exam (in class) *tentatively* scheduled for Thursday, October 31st. Duration: 1h15mins.
- Final exam (30%): The final exam date/time will be announced by the Registrar's Office at time specific.

All exams will be closed book with two sheets (both sides, letter paper) of notes allowed. No computation tools allowed other than a hand-held calculator. Students bring their own paper for the exams.

**Working Together:** Collaborative study is encouraged; however submitted work (quizes, project) is personal and the submissions should *clearly* reflect.

**Absences:** You are expected to attend every class. It is not acceptable to give priority to assignment completion over class attendance. Nonetheless, attendance will not strictly be kept.

**Plagiarism:** The University's minimum penalty for cheating or plagiarism is a failure in the course.

**Intellectual Property:** No student may distribute notes, audio-visual or other material from the class, whether or not for a fee. If any UD student, whether enrolled in the class or not, distributes such material in contradiction of this prohibition, (s)he will be in violation of the Student Code of Conduct.