1. Course Number and Name

ENME482L Vibrations and Controls Laboratory

2. Credits and Contact Hours

- 2 credits: 2 lecture + 2 laboratory periods/week for 6 weeks

3. Instructor

Dr. Neil Rothman, nrothman@umbc.edu
If you email me, please include the course number in the subject line (ENME482L).
Office: ENGR 221
Office Hours: As posted on Blackboard and by appointment

Open Door Policy:

- If my door is open/ajar, I may be meeting with another student, so please knock softly so I know you're there. You may have to wait a few minutes.
- If my door is closed, I'm occupied. Please come back at another time.

Telephone:
410-455-5507 (UMBC campus)
Before you call or email, please check the course Blackboard site for questions on assignments, etc.

4. Teaching Assistants

Jason Dunthorn – jasond2@umbc.edu
Ross Kistler – kistler1@umbc.edu
Office Hours: as posted on Blackboard.

5. Textbook

None

6. Course Description

This course is intended to reinforce the concepts learned in ENME360 Vibrations and ENME403 Automatic Controls through hands-on experiments. Students will utilize standard test, measurement, and analysis equipment and computer based data acquisition and control systems typically found in industry.

Controls Concepts
Systems, input/output relationship, synthesis, modeling (physical system vs. mathematical)
Analytical tools (e.g., Laplace transforms)
Time response of a linear dynamic system
Frequency response (magnitude and phase as a function of frequency), bandwidth, stability margins
Design of feedback systems to meet steady state and transient performance requirements

Vibrations Concepts
Free vibration and forced response
Under-, critical- and over-damped vibrations
Natural frequencies, modal analysis

7. Specific Course Information

The course will consist of 10 experiments, which will be performed with a partner. Each group will be responsible for submitting a laboratory report for each experiment. The experiments will be as follows:

- Lab #1 - Laboratory equipment familiarization, including data acquisition using conventional test and measurement equipment and National Instruments Labview/ELVIS; effects of sampling rate and filtering
- Lab #2 - First order thermal system: thermocouple/thermistor response
- Lab #3 - First and second order electrical systems: time and frequency domain response
- Lab #4 - Second order undamped mechanical system: response of a cantilever beam; time domain and frequency domain analysis
- Lab #5 - Second order mechanical system: damped spring mass system; time domain and frequency domain analysis; determining time constants, natural frequencies, and effects of varying the damping coefficient
- Lab #6 – Vibration isolation
- Lab #7 – Motor control: PID control of a servo
- Lab #8 – Feedback controller design: linear actuator control (2 sessions)
- Lab #9 – Actuator control integrated in a control system: balancing a seesaw (2 sessions)
- Lab #10 – TBD

Each laboratory experiment will have an associated pre-laboratory assignment that will require students to create a mathematical model of the system being investigated and/or simulate the behavior of the system using Matlab. Students will build the data acquisition and/or control systems using Labview and evaluate the performance of each physical system. This will give students the end-to-end experience of modeling, controlling, and evaluating a dynamic system using typical engineering test and measurement tools, as well as the opportunity to observe the differences between ideal system analysis and actual system performance.

Prerequisites: ENEE 302, ENME 360, and ENME 403

Required course for Senior ME students

8. Specific Goals for Course

After completing the course, students will have demonstrated the ability to:

- Model and evaluate the behavior of dynamic systems using differential equations and control systems methods
- Utilize laboratory test and measurement equipment to evaluate the behavior of dynamic systems and control systems
- Design, build, simulate, and test control systems using Matlab and Labview

9. ABET Criteria

(a) Apply knowledge: laboratories require students to apply their knowledge of vibrations, control systems, and differential equations to system modeling, simulation, and evaluation

(b) Design and conduct experiments, analyze and interpret data: students conduct experiments to evaluate the behavior of dynamic systems, interpreting their data to better understand test and measurement and the design and evaluation of control systems

(d) Teamwork: students work in teams to perform laboratory experiments and on projects

(e) Solve problems: posing a problem to be solved and then developing experiments to evaluate a solution are required for each experiment.

(g) Communication: students prepare written reports for each experiment and give oral presentations on their team projects

(k) Application to practice: dynamic system design, controller design, and the use of laboratory instrumentation and data acquisition equipment are skills required of professional engineers. Students develop and apply these skills throughout the course.

10. Policies and Procedures

Work is due on time. Pre-labs and laboratory reports must be submitted as a pdf file before lecture on the day they are due. Not an hour late or the next day.
Everything Counts: Follow the report guidelines on Blackboard. Content is most important, but grammar, spelling, format, etc. count in everything you write.
Mobile Phones: Phones/texting can be a distraction to you, me, and the rest of the class. Please be considerate and put phones away during class.

11. Grading

Laboratory reports – 65%
- Technical content – 50%
- Clarity and completeness – 40%
- Format, grammar, etc. – 10%

Pre-lab Assignments – 30%
Teamwork (peer evaluation) – 5%

Weighted sum ≥ 90 = A
Weighted sum ≥ 80 = B
Weighted sum ≥ 70 = C
Weighted sum ≥ 60 = D
Weighted sum ≤ 60 = F

12. Academic Honesty

By enrolling in ENME482L, each student assumes the responsibilities of an active participant in UMBC's scholarly community, in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit

these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal.

The full Student Academic Conduct Policy is available in the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Directory.

Students will not be required to sign a confirmation of compliance with these policies, but will be held to this standard in all effort associated with the course.

Failure to comply with the requirements of the Student Academic Conduct Policy may result in failure of ENME482L.

13. Course schedule

The course schedule is posted on Blackboard.

Neil S. Rothman, Ph.D.
July 2014