*ENGG*3410*

Systems and Control Theory

Winter 2008

Instructor:

- Simon Yang **Office:** Room 2387; **Phone:** ext. 52437; **E-mail:** syang@uoguelph.ca
  Office hours: 9:30-11:30 am, Wednesday

Lab Instructor:

- Hong Ma **Office:** Room 1126; **Phone:** ext. 53873; **E-mail:** hongma@uoguelph.ca

GTAs:

- Raef S. Shehata and Shanghong Peng

Text Book:

- ***Modern Control Systems, 11th Edition,*** by Dorf & Bishop, Prentice-Hall. (Text book)
- ***Analog & Digital Control Systems Design,*** by Chen, Oxford. (Reference book)
- ***Control Systems Engineering, 4th Edition***, by Nise. John Wiley & Sons. (Reference book)
- ***Modern Control Systems & Design using Matlab and Simulink***, by Bishop, Addison-Wesley. (Reference book)

Course Web Page:

- http://www.uoguelph.ca/~syang/Engg3410

Course Email Listserv:

- engg341@aris.eos.uoguelph.ca

Schedule:

• Lectures	Tue. & Thu.	11:30-12:50 pm	LA 204
• Labs	Tue.	2:30-4:20 pm	THRN 1126 (Section **101**)
	Mon.	8:30-10:20 am	THRN 1126 (Section **102**)
	Thu.	2:30-4:20 pm	THRN 1126 (Section **103**)
	Wed.	8:30-11:20 am	THRN 1126 (Section **105**)

Course Objectives:

Students who successfully complete this course will be able to:

- Have a general understanding of control systems, including system modeling, performance analysis and control design of various control systems;
- Develop mathematical models for a simple engineering, physical and biological systems;
- Perform system analysis of a control system;

- Design proper controller for a control systems to achieve certain specifications;
- Apply control systems theory to a real engineering, physical or biological system.

Course Description:

This course will focus on several topics covering modelling, performance analysis and control with potential application to engineering, physical and biological systems. Topics include modeling in time, Laplace and frequency domains; performance and stability by methods of Hurwitz, Routh, Bode and Nyquist; and control by On/Off and PID controllers. A brief introduction to digital control systems and programmable logic controllers (PLC) will also be covered.

Prerequisites:

- ENGG*2400; MATH*2270

Note: Failure to have a signed waiver will result in an automatic drop from the course.

Grade Evaluation:

- Assignments 10%
- Quizzes 10%
- Labs 20%
- Midterm 20%
- Final Exam 40%

Notes:

- To reinforce the lecture material, mostly every other week a new assignment will be introduced in the lecture. Assignments are due at 11:00 am on the same day, one week after that lecture. Individual and original assignments are to be submitted by each student. Assignments are to be submitted in the appropriate box in the foyer of the engineering building. *Late assignments will not be accepted***.**
- The **mid-term** test is scheduled for *Tuesday, **Feb. 26**, 11:30-12:50, in class.*
- The **final exam** is on *Saturday, **April 12**, 7:00-9:00 pm.*
- **Academic Misconduct:** Please refer to the regulations outlined in the student handbook.
- **Major Holy Days:** The student must contact the instructor within the first two weeks of class if academic consideration is to be requested due to religious reasons.

Laboratory:

You will conduct five labs: (1) On/Off Controller; (2) Motor Controller; (3) PID Controller; (4) System Identification; and (5) System Simulation using Matlab. ***Lab sign up** is in the first week (by Friday Jan. 11). Labs start in the third week.*

Working Group: You will be organized in lab groups of a maximum of **three** people, either by yourself or by the lab instructor. You will work in these groups for all labs, at the same time slot, throughout the course. Once the groups have been established, there will be no opportunity to change. So choose your partners carefully. Sign-up sheets for lab groups will be

posted outside the lab during the first week of lectures. Each group will turn in one report for each lab exercise. A single mark will be allocated to each group for each lab. No individual grades are given. However, any evidence that a student is relying on partners to do a disproportionate amount of work will lead to penalization of that student, due warning have been given.

Lab Mark: The lab mark will be mainly based on your lab report. However, 20% of the mark for a lab is allocated to in-lab demonstration. When you have completed a particular lab exercise, the lab TA will evaluate your performance by verifying that the system works according to the specification. In case you do not manage to finish a lab, this will be noted on the lab-attendance sheet, and you should also state this in your lab report and describe what you would have done if you had more time to complete the exercise.

Lab Report: The lab report should include the follows: (1) Executive Summary; (2) Introduction; (3) Equipment; (4) Experimental Setup; (5) Block Diagram; (6) Procedure; (7) Discussion; and (8) Conclusion. Detailed instruction on lab report will be given in the first lab.

Safety: To ensure safety of yourself and others, please abide by the lab safety regulations. The lab instructor will explain them to you in details during your first lab session.

Course Topics (tentative):

1. Introduction to control systems
2. Mathematical models of systems
3. State variable models
4. Feedback control system characteristics
5. The performance of feedback control systems
6. The stability of linear feedback systems
7. Root locus analysis and design
8. Frequency response methods
9. Stability in the frequency domain
10. The design of feedback control systems
11. Programmable logic controllers (PLC)
12. Digital control systems