DR. JULIE VALE

ENGG*3410 SYSTEMS AND CONTROL

WINTER 2013

Course Outline

Instructor: Dr. Julie Vale, THRN 2333, 519-824-4120 ext. 54863, jvale@uoguelph.ca

Teaching assistants:

TA	Contact Info	Duties
Cloutier, John	jcloutie@uoguelph.ca	Tutorial
Jiang, Xia	xjiang01@uoguelph.ca	Lab 1
Mason, Cynthia	cmason01@uoguelph.ca	Lab 4
Seth, Nitin	sethn@uoguelph.ca	Lab 3
Stachowsky, Michael	mstachow@uoguelph.ca	Tutorial
Zhao, Han	hzhao03@uoguelph.ca	Lab 2

Please note that you may also wish to make use of peer helpers: engpeers@uoguelph.ca

Laboratory technician: Hong Ma, hongma@uoguelph.ca

Textbook: Stefani, Shahian, Savant, and Hostetter, "Design of Feedback Control Systems", fourth ed., Oxford University Press.

Communication is predominantly through announcements in class. Some information will be posted on courselink or sent via email messages to your University address. Due to the large class size, please do not expect instant reply to your emails: I will respond daily during the week and sporadically on the weekends.

If at any time you have concerns about the teaching approach, the examinations, the TAs etc., please contact me as soon as possible: if there is a problem with the course or the personnel and I don't know about it, then I can't do anything to fix it. If you feel that you can't discuss the matter with me, please feel free to contact your TAs, the Peer Helpers, or Administration.

If you are ill, call the Student Health Services or a medical doctor. If you have emotional, family, or living environment problems that affect your ability to study, visit the Counseling Services or your academic advisor. If you have a disability or a temporary disability, refer to the Centre for Students with Disabilities.

If there are conflicts with religious obligations, please contact me within the first two weeks of class and I will find a way to accommodate you.

In all cases, you are welcome to discuss your specific needs with me; please do so at the earliest possible time.

Meetings

Lectures: Tuesdays and Thursdays 10:00-11:30, THRN 1200

Tutorials:

1) Monday 2:30PM - 3:20PM, MACK, Room 116
2) Wednesday 9:30AM - 10:20AM, CRSC, Room 117
3) Wednesday 11:30AM - 12:20PM, CRSC, Room 116
4) Friday 3:30PM - 4:20PM, MACK, Room 116

Laboratories:

Labs are in THRN 2196. Please go to the laboratory section that you selected in webadvisor. Attendance will be taken at the lab. If you are not present for your lab, you will get a zero on that lab.

Unfortunately all of the lab sections are all full! This means that you will **not** be allowed to attend a lab section that you are not scheduled for.

Lab 1: week 2 (week of January 14).

Lab 2: week 5 (week of February 4).

Lab 3: week 7 (week of February 25).

Lab 4: weeks 9 and 10 (weeks of March 11 & 18).

Pre-lab: Some of the labs have a *mandatory* prelab. Your group must submit your prelab upon arriving to your scheduled lab section. You will not be allowed to enter the lab if your prelab is incomplete.

Since all lab sections are full, we can not allow you to attend a later lab if your miss your scheduled time due to a missing prelab; therefore, **if your prelab is incomplete, then you will get an automatic zero on that lab.** IF the enrollment situation changes significantly, then we may be able to be more flexible with respect to this rule.

Labs are due at 4:30pm exactly one week after the day that you do the lab, so if your lab is on a Monday, then your submission is due the following Monday at 4:30pm. We will be trying to use courselink for submissions (which will have to be in PDF form), but if that is not feasible, then you will submit your lab in hard copy to one of the drop boxes in the THRN hallway. Late submissions will be penalized at a rate of 10% per day.

Note that weekends count as days, so if your lab is due at 4:30pm on Friday and you hand it in at 5:00pm on Monday, that is three days and 30%.

Midterm: Tentatively scheduled for Feb 14 10-11:30pm, THRN 1200.

Final exam: April 19, 11:30am-1:30pm

Office hours: I am trying something new for office hours this year. Instead of one-on-one Q&A in my office, I will be holding open office hours in THRN 1427 (just off of the atruium) on Tuesday at 12-1 and

Thursday at 1:30-2:30. There will be a TA in the room as well. These sessions will be shared with the other two courses that I am teaching (Systems and Control and Digi-Pro). This gives you the opportunity to get help from me, your TAs, and your direct peers, all in one easy to access location. Sessions will be open access and open forum. Content and delivery (e.g. question and answer, problem solving, group work, mini-lectures, etc.) will be decided by whoever shows up. I **strongly** encourage you to attend these sessions, especially if you are having difficulty with course content or solving the homework problems.

I have chosen times with the goal of reducing conflicts as much as possible, but I know that some of you have conflicts with these times. If you need help and can not attend the office hours or if you want to meet privately, please contact me or your TAs directly and we will set up a time that works for both you and us. Please note that I have a heavy teaching load this term, so I am not always available... I have posted my general availability on the board outside of my office.

Course Description and approach

Prerequisites: Success in this course requires the fundamentals of systems (e.g., first and second order systems, transfer functions, step and impulse responses, etc.), the fundamentals of engineering mathematics (linear algebra, complex numbers, Laplace transform, etc.), and good problem solving skills.

Courses: As stated in the Undergraduate Calendar.

This course explores the fundamentals of systems and control. The course has two primary focuses: understanding and predicting system behaviour and design and analysis of closed loop control systems.

After successfully completing the course you will be able to analyze a system model and design a controller to achieve given objectives for that system. To this purpose you will learn to

1) apply systems theory to complex real world problems in order to obtain models and predict system behaviour

2) analyze the behaviour of closed loop systems using tools such as root locus, Routh Hurwitz, Bode, and Nyquist

3) design controllers using classical PID methods, root locus methods, and frequency domain methods.

Sample problems are provided at the end of each chapter. Solu-

There are many learning styles; for example, some people need to have solutions to ensure that they don't practice a 'wrong' technique. That said, please do not simply copy the solutions... this will not help you learn!

tions will be provided. These problems will not be graded.

Laboratories allow you to explore real physical systems and their behaviours. There are ***four*** laboratory reports to be completed individually or in groups of three. Any student not handing in an assignment or a report receives a grade of zero. There are no makeup labs.

The midterm and the final exam are comprehensive. The use of notes, books, calculators, or other aids is not permitted at exams. Any student not taking an exam receives a grade of zero for that exam.

If you have a legitimate reason for missing the midterm, I may consider accommodation upon presentation of a written request and suitable documentation. I will determine what constitutes a legitimate reason. If you miss the final exam for any reason, you must contact the engineering counselor, **not me**.

Evaluation

The breakdown for grading the course is given below. It is based on the premise that you must pass either the midterm of the final in order to pass the course while ensuring that there are no step discontinuities in the grades (e.g. getting a 50% on the final exam versus a 49% will not change your grade from 70% to 49%). Furthermore, if you do better on the final exam than the midterm, the final will have a higher weighting.

The ideal weighting (i.e. if you get over 60% on everything and do better on the final than on the midterm) is
midterm=20%
final=60%
labs=20%.

Define: Final Grade := G, Final exam := F, Midterm exam := M, and Laboratory reports := L (all in percent), then set

$$E := \frac{1}{0.8}\max\{0.6F + 0.2M, 0.5F + 0.3M\}$$

and

$$x := \frac{E - 40\%}{20\%}.$$

If $E = 40$ then $x = 0$ and if $E = 60$ then $x = 1$.

Your final grade is then given by

$$G := \begin{cases} 0.8E + 0.2L, & E \geq 60\% \\ \min\{(1-x)E + x(0.8E + 0.2L), \\ \qquad 0.8E + 0.2L\}, & 40\% \leq E \leq 60\% \\ \min\{E,\ 0.8E + 0.2L\} & E \leq 40\%. \end{cases}$$

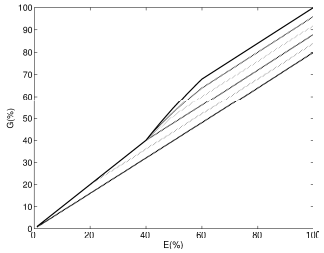

Figure 1: How your final grade varies with E; different lines indicate different Lab grades: L ranges from 0% to 100%.

Scholastic integrity

The value of an academic degree depends on the integrity of the work done to earn that degree. It is imperative that you keep a high level of honour in your work. This course is foundational for many of the courses that you will take in upper years. If you fail to uphold personal ideals of academic integrity, then you will have a more difficult time understanding and appreciating the material in those upper year courses. Furthermore, if your colleagues fail to uphold these ideals, then the value of your degree is degraded. To that end, it is your responsibility not only to be honest in your own work, but also to encourage others to be honest in theirs.

If you feel that the structure of the course lends itself to academic dishonesty, then please contact me with your ideas on how to change the course to promote honesty and deeper learning.

Academic misconduct, such as plagiarism, is a serious offense at the University of Guelph. The policies on scholastic dishonesty reported in the Undergraduate Calendar will be enforced. Please consult the Undergraduate Calendar 2010-2011 and School of Engineering programs guide, for offences, penalties and procedures relating to academic misconduct[1]. I recommend that you review the tutorial at academicintegrity.uoguelph.ca and that you discuss any questions that you may have with me or the teaching assistants.

[1] http://www.uoguelph.ca/registrar/calendars/undergraduate/current/co8/co8-amisconduct.shtml

In this course, you will be required to submit lab reports. Please note that directly copying text or figures without citing them is plagiarism, even if you found the material on the Internet or got it from a friend. If you paraphrase information from a source (including redrawing a figure with minimal changes), you must also reference it.

Topics

Lecture material

Major Section	Content
Signals and Systems	Linearity, Time invariance, and Causality; solving systems using Laplace; stability; Bode Plots; 1st, 2nd, and higher order systems; Block diagram manipulation
Closed loop stability	the characteristic polynomial, Routh Hurwitz, Nyquist
Controller design	specifications, final value theorem, Root locus, Frequency domain methods
Applications	PID , lead, and lag control
Modeling	Physics, State space,Linearization

Laboratories

Topic	Content
Lab 1: On/Off	Bang bang control, fundamentals of feedback
Lab 2: Matlab	Software only: Using Matlab with a focus on control related commands
Lab 3: System Identification	Model a DC motor
Lab 4: PID design lab	Investigate behaviour of different PID gains, then design a PID control to achieve an objective

Disclaimer: I reserve the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph academic regulations.