ENGG*3410
Systems and Control Theory
Winter 2017

UNIVERSITY of GUELPH

School of Engineering

(Revision 2: January 10, 2017)

1 INSTRUCTIONAL SUPPORT

1.1 Instructors

Instructor:	Simon Yang, Ph.D.
Office:	RICHS 2513, ext. 52437
Email:	syang@uoguelph.ca
Office hours:	10-11 am, Tuesday, or by appointment

1.2 Lab Technician

Technician:	Hong Ma
Office:	THRN 1506, ext. 53873
Email:	hongma@uoguelph.ca

1.3 Teaching Assistants

GTA	Primary Task	Email	Office Hours
Jesse Knight	Tutorial	jknigh04@uoguelph.ca	TBA on Courselink
Mohammadhossein Hajyian	Tutorial	mhajiyan@uoguelph.ca	TBA on Courselink
Yasaman Daneshi	Lab 1	ydaneshi@uoguelph.ca	TBA In lab
Ahmed Elsaftawy	Lab 2 and 3	elsaftaa@uoguelph.ca	TBA In lab
Negin Lashkari	Lab 4, Lab 5, and some tutorials	nlashkar@uoguelph.ca	TBA in lab
Titus Cheruiyot	Lab support	tcheruiy@uoguelph.ca	TBA In lab
Soroush Ebadi	Lab support	sebadi@uoguelph.ca	TBA In lab
Jinrui Liu	Lab support/Courselink	jlu10@uoguelph.ca	TBA In lab

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*3410 Courselink site. You are responsible for checking the site regularly.

2.2 Recommended Resources

1. Norman S. Nise *Control Systems Engineering: 7th edition* Wiley, 2015.

2.3 Additional Resources

Lab Information: The lab manuals and rubrics will be posted in the lab section of the Courselink page.

Problem sets: Additional homework problems may be posted in the 'problem sets' section of courselink. Solutions to selected questions will be posted to the same section in Courselink by the instructor and the GTAs. **Homework problems will not be graded.**

2.4 Communication and Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly**. As per university regulations, all students are required to check their mail.uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

Important: When writing email to course staff (instructors, TAs, or lab techs), please be professional in your communication. Unprofessional emails will not be responded to. This includes those using l33t, text messaging shorthand, a complete lack of punctuation or capitals, etc.

3 ASSESSMENT

3.1 Dates and Distribution

Note that reading week occurs between weeks 6 and 7.

Labs: Please see section 5.3 below for information regarding in-lab dates and times. Lab reports are due at 4:30pm on the week indicated in Section 5.3 on the day of the week corresponding to your lab section (i.e., if your lab is on a Monday, then your submission is due on a Monday at 4:30pm in the week indicated below). You must submit your lab using Courselink. The final writup for lab 5 must be submitted in softcopy on courselink **and** in hardcopy in the SOE submission boxes (box number 18).

Midterm Feb 28 (Tuesday), in class

Final Exam: April 17, 14:30-16:30, location TBD on Webadvisor.

The breakdown for grading the course is given below:

Labs and Prelabs: 25%
Midterm: 35%
Final: 40%

Prelabs weights: Prelab 2 is 1%, Prelab 3 is 2%, Prelab 5 is 2%, (for a total of 5%).
Labs are not equally weighted: Lab 1 is 2%, Lab 2 is 3%, Lab 3 is 4%, Lab 4 is 5% and lab 5 is 6% (for a total of 20%).

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email both course instructors. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email both course instructors within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Consideration of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Missed midterms If you miss the midterm due to grounds for granting academic consideration or religious accommodation, the weight of any missed test will be added to the final exam weight. There will be no makeup tests. No extra time will be given to students who arrive late.

Midterm and Final exams For both exams you are allowed to *bring your own* only one aid sheet A4 size (you can write on both sides) that can only have formulas (No solved problems, no derivations, no description, no explanation, no figures, no diagrams, no graphs, no curves, no tables, etc.) Any deviations from this will result in 40% deduction of your exam mark.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab.

Attendance will be taken in the lab. All students are required to demo their lab during their lab session; this demo is graded. If you are not present for your lab and your demo, you will not be allowed to submit a lab report and you will get a zero on that lab. If you miss more than 25% of a lab period due to lateness or by leaving before you have finished the lab, you will be considered absent. Some labs are scheduled to take place over two weeks; if you complete your lab in the first week, you do not need to attend the second week.

Pre-lab: Some labs have a *mandatory* prelab. Prelabs will be posted on the Courselink. Your group must submit your prelab 24 hours prior to arriving to your scheduled lab section. Your prelab will be graded by the TA before you enter the lab. You should arrive at the lab already having looked at the feedback from your prelab. You will not be allowed to enter the lab if your prelab is incomplete or missing. 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.

Late Lab Reports: **Late submissions of lab reports will be penalized at a rate of 10% per hour.**

All labs and prelabs are submitted via courselink. It is your responsibility to ensure that your lab has been properly submitted, not your lab partner's. Double check that the correct file has been uploaded to the drop box. If you upload the incorrect file or fail to upload properly and do not fix the problem before the due date, you will be penalized according to the late submission rules: there will be NO exceptions. If you are having trouble submitting to courselink, email a copy of your report to the TA or submit a hard-copy before the deadline to provide proof that you completed the lab on time. A date stamp on a soft copy file DOES NOT constitute proof of timely completion.

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4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

Modeling, 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. Control by ON/OFF and PID Controllers.
Prerequisite(s): **ENGG*2400,Math*2270)**
Corequisite(s): **ENGG*2450)**

4.2 Course Aims

This course explores the fundamentals of systems and control. The course has two primary focuses: (1) understanding and predicting system behaviour and (2) design and analysis of closed loop control systems.

4.3 Learning Objectives

At the successful completion of this course, a student will be able to:

1. **apply systems theory to complex real world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations**

2. **predict system behaviour based on the mathematical model of that system where the model may be expressed in time or frequency domain**

3. **analyze the behaviour of closed loop systems using tools such as root locus, Routh Hurwitz, Bode, Nyquist, and Matlab**

4. **design controllers using classical PID methods, root locus methods, and frequency domain methods**

5. devise a safe and effective method of investigating a system identification problem in the lab

6. write a report that effectively communicates the results of an experiment or design

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base	1-5	All
2. Problem Analysis	1-5	Exams, labs
3. Investigation	5	Lab
4. Design	4	Labs, exam
5. Use of Engineering Tools	3-4	Labs
6. Communication	6	Lab reports
11. Environment, Society, Business, & Project Management	5	

4.5 Relationships with other Courses & Labs

Previous Courses:

ENGG*2400: System fundamentals, linear equations, responses, solving differential equations

MATH*2270: Linear differential equations, responses, solving differential equations, Laplace transform

ENGG*2450: Foundations of systems analysis, frequency response, RLC circuit analysis, ideal operational amplifiers

Follow-on Courses:

ENGG*3490: Foundations of systems and control, system responses, stability, PID

ENGG*4280: Everything

ENGG*4430: Foundations of systems and control, closed loop control

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Tuesday		**13:00 - 14:20**	**ALEX 100**
Thursday		**13:00 - 14:20**	**ALEX 100**

Laboratory:

Monday	**Sec 1x**	**08:30AM - 10:20AM**	**RICH 1504**
Tuesday	**Sec 2x**	**08:30AM - 10:20AM**	**RICH 1504**
Wednesday	**Sec 3x**	**08:30AM - 10:20AM**	**RICH 1504**
Thursday	**Sec 4x**	**08:30AM - 10:20AM**	**RICH 1504**
Friday	**Sec 5x**	**08:30AM - 10:20AM**	**RICH 1504**

Tutorial:

Monday	**Sec x1**	**19:00 -19:50**	**MCKN 116**
Monday	**Sec x2**	**19:00 -19:50**	**MCKN 121**
Tuesday	**Sec x3**	**19:00 -19:50**	**MCKN 116**
Tuesday	**Sec x4**	**19:00 -19:50**	**MCKN 121**
Wednesday	**Sec x5**	**19:00 -19:50**	**MCKN 116**
Wednesday	**Sec x6**	**19:00 -19:50**	**MCKN 121**
Thursday	**Sec x7**	**19:00 -19:50**	**MCKN 116**
Thursday	**Sec x8**	**19:00 -19:50**	**MCKN 121**

5.2 Lecture Schedule

Lecture(s)	Topic
1-2	**Topic 1 – Introduction to systems, Math review (Laplace, partial fractions, etc.)**
3-4	**Topic 1,2 – Transfer functions: FVT**
5-9	**Topic 3 – Modeling in time domain: linearization, state-space**
10-11	**Topic 4 – Time response (transient chracteristics)**
12-14	**Topic 5 – Stability, steady-state errors**
15-16	**Topic 6 – Introduction to Control: closed loop systems, block diagrams**
17-20	**Topic 7 – Root locus, PID control**
20-23	**Topic 8 – Frequency design: Bode, Nyquist**
24	**Topic 9 – More control design: lead-lag**

5.3 Lab Schedule

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. Please go to the laboratory time and date that corresponds to the section that you selected in webadvisor.

Week	Lab	Due dates
1	Safety lab (in the lab)	
2	Lab 1: On/Off lab	
3	Lab 2: MATLAB	Lab 1 Due
4		Lab 2 Due
5	Lab 3: Modeling	
6		Lab 3 Due
7	Reading week!	
8	Lab 4: PID investigation	
9		Lab 4 due
10	Lab 5 (day 1): PID design	
11	Lab 5 (day 2): PID design	
12		Lab 5 Due

Note: Week 1 is the week of January 9.

5.4 Other Important Dates

Monday, January 9, 2017: First day of class

Monday, February 20 - Friday, February 24, 2017: Winter Break

Friday, March 10, 2017: drop date - 40th class

Friday, April 7, 2017: last day of class

6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

If the laboratory rules are not followed, consequences will include removing access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the

University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

9 RECORDING OF MATERIALS

Presentations which are made in relation to course work-including lectures-cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs: http://www.uoguelph.ca/registrar/calendars/index.cfm?index