University of Victoria Engineering

Faculty of Engineering
Department of Mechanical Engineering
COURSE OUTLINE

Course Name Number (MECH 380) – Automatic Control Engineering

Term – FALL 2014 (201409)

Instructor	**Office Hours**
Dr. Yang Shi	Days: Monday and Thursday
Phone: 250-853-3178	Time: 12PM-1PM
E-mail: yshi@uvic.ca	Location: EOW-519

List all prerequisites and co-requisites:
MECH 330

LECTURE DATE(S)

Section:	Days:	Time:	Location:
A01 /CRN12317	Monday and Thursday	2:30 pm - 3:50 pm	ECS 125

TUTORIAL SECTIONS

Section: T	Days:	Time:	Location:
T01	Friday	05:30 - 06:20 pm	HSD A240

LAB SECTIONS

Section: B (Multiple)	Days:	Time:	Location:
Lab #1: B01	Wednesday	08:30 – 11:20 am	ELW B232
Lab #2:	Wednesday	02:30 – 05:20 pm	ELW B232
Lab #3:	Thursday	04:00 – 06:50 pm	ELW B232
Lab #4	Friday	08:30 – 11:20 am	ELW B232

Lab times and locations are also available from the timetable through Sign in to UVic, My Page.

TA Name	**E-mail**	**Office**
Bingxian Mu	bxmu@uvic.ca	EOW A148
Basem Badr	bbadr@uvic.ca	ELW A247
Xi Zheng	xizheng@uvic.ca	ELW A236
Sahand Behboodi Kalhori	behboodi@uvic.ca	EOW A227
Nima Harsamizadeh Tehrani	nimahat@uvic.ca	ELW A246

Required Text	**Optional Text**
Title: Control Systems Engineering, Sixth Edition	
Author: Norman S. Nise	
Publisher/Year: Wiley, 2010	
Reference Materials:	

Learning Outcomes next page

COURSE OBJECTIVES:

This course is directed towards those who seek to grasp the fundamentals of feedback control theory. The concepts of Laplace Transforms, their applications to obtaining transfer functions of physical systems and the *s*-domain analysis are key to the understanding of the course material. An understanding of the stability analysis is critical to the design and analysis of control systems. Both time and frequency domains are considered in detail so that the student can appreciate both design perspectives and learn the classical feedback control strategies. Practical control examples are discussed wherever appropriate.

LEARNING OUTCOMES:

Students are expected to achieve the following learning outcomes:

- Describe the basic properties and have a physical understanding of control systems
- Identify the control objectives for control systems.
- Describe how the models of linear dynamic systems are derived.
- Derive the transfer function of a system.
- Describe the characteristics of first-order and second-order dynamic systems.
- Identify the model parameter of first-order and second-order dynamic systems.
- Perform the root-locus analysis.
- Analyze the stability of a dynamic system.
- Analyze the transient and steady-state responses.
- Design controllers by satisfying prescribed requirements.
- Identify frequency responses of linear dynamic systems.
- Apply frequency response concepts to design compensators.

Weight & Date(s) of Assessments:	**Weight**	**Date**
Assignments:	15%	
Labs	10%	
Mid-term	25%	Date: November 5, 2014
Final Exam	50%	Date: December 13, 2014

ASSIGNMENTS (Include Assignment Schedule) (Description & Method of Delivery)

- Weekly assignments are to be given and are due the following week by 4:00PM; please drop your assignments in the MECH 380 Assignment Box.
- Please note that *late* assignments will not be accepted unless a legitimate reason (illness, religious conviction, etc.) exists and is discussed with the instructor.
- Solutions to the assignments will be prepared by the instructor, but your assignments will be marked by TAs. Solutions will be available on the course web-site.

Assignment #	Modules	Start	Due (5 pm)
1	To understand the basic concepts of control systems, modeling of physical systems using general block diagrams, and preliminary design of a control system	Sept.12, 2014	Sept. 19, 2014
2	To understand the basic concepts of Laplace Transform, applications of Laplace Transforms, and the concept of transfer function.	Sept. 19, 2014	Sept.26, 2014
3	To understand the basic concepts of Laplace Transform, the inverse Laplace Transform, applications of Laplace Transforms to solutions of differential equations, and the concept of transfer function.	Sept.26, 2014	Oct.3, 2014
4	To understand the basic concepts of Laplace Transform, the inverse Laplace Transform, the application of Partial Fraction Expansion in obtaining the inverse Laplace Transform, as well as the Final Value Theorem and the associated conditions of existence.	Oct.3, 2014	Oct.10, 2014
5	To understand the concepts of transfer functions, block diagram transformations, and signal flow graphs.	Oct.10, 2014	Oct.17, 2014
6	To understand the concept of transfer functions, block diagram transformations and signal flow graphs.	Oct.20, 2014	Oct.27, 2014
7	To understand the transient response characteristics of first- and second-order systems.	Oct.24, 2014	Oct.31, 2014
8	To understand the R-H array method for stability analysis and controller design.	Nov. 19, 2014	Nov.26, 2014
9	To apply the root locus method to the controller design	Nov.27, 2014	Dec.4, 2014

LABORATORIES (Description & Method of Delivery)

There are three labs.

- All labs are conducted in ELW B232 during the schedule time by lab TAs.
- Before coming to the Lab, students should carefully read the lab manuals and complete the pre-lab questions.
- The Lab TAs are responsible for marking the lab reports.
- One lab report will be prepared per group, per laboratory.
- The lab reports will be due one week after the completion of the scheduled lab session and will be submitted into the MECH 380 drop box.
- Lab reports should be neat and clear. They should be stapled or contained in a standard lab book.

Lab #	Modules	Start	Due (5 pm)
1	DC Motor System Modeling and Parameter Identification	10.07	10.21
2	DC Motor Speed Control	10.21	11.04
3	DC Motor Position Control	11.04	11.18

PROJECTS: (Description & Method of Delivery)

NOTE:

- **Tutorial**
  The tutorial will provide students with a chance to review relevant problems with the instructor or teaching assistants, and ask questions regarding the class material. Although the tutorials are not compulsory, students are encouraged to attend all the tutorials.

- **Getting Help**
  Students are welcome to drop by my office (EOW 519) anytime for help. Alternatively, you can telephone or e-mail me to make an appointment.
  Scheduled office hours: Monday and Tuesday 1PM-3PM

- **Test and Exam**
  There are a midterm test and a final exam:
  - In the test and exam, you can bring a two-sided formula sheet (8 by 11 in); but no books, class notes, or other materials are allowed.
  - In the test and exam, only silent calculators are permitted.
  - The midterm test will be conducted on **Nov. 5**, during the lecture period, namely, from 2:30 PM to 3:50 PM in the lecture classroom.
  - The final exam is scheduled by the Registrar's Office.

- **Plagiarism and Such**
  The University of Victoria is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students should avoid any behavior which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offense. Academic dishonesty is a serious offense and can result in suspension or expulsion from the University.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

Assignment of E grade and supplemental examination for this course will be at the discretion of the Course Instructor. The rules for supplemental examinations can be found in the current Undergraduate Calendar.

GENERAL INFORMATION

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

"**Attendance**

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time….

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course." UVic Calendar, (2015) http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/Atte.html

Accommodation of Religious Observance (AC1210)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Discrimination and Harassment Policy (GV0205)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Faculty of Engineering, University of Victoria
Standards for Professional Behaviour

"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty, to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals…."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities. http://www.uvic.ca/engineering/current/undergrad/index.php#section0-23

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity
http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/PoAcI.html

Course Schedule

Module	Topics	Date/Week
1	Linear System Models. Mathematical models of physical systems, transfer functions representation	09.04-09.18
2	Time Response and Stability. First and second order system responses, BIBO stability, Routh-Hurwitz stability criterion	09.22-10.06
3	Block Diagrams and Signal Flow Graphs. Block diagrams of systems, block diagram reduction, signal flow graphs of systems, Mason's formula	10.09-10.17
4	Feedback Control System Characteristics. Transient response, system specifications and performance analysis, and steady-state analysis	10.20-11.07
5	Dynamic Compensation. Feedback compensation, lead-lag compensation	11.10-11.13
6	Root Locus Analysis and Design. The root locus method, rules for root locus plotting and construction of root locus, root locus design	11.17-11.24
7	Frequency Response Analysis and Design. Frequency response, Bode plots and Nyquist diagrams, stability criterion, gain and phase margins, compensator design in the frequency domain	11.27-12.01