University of Victoria Engineering

Faculty of Engineering

COURSE OUTLINE

MECH 380 – Automatic Control Engineering

Term – Fall 2015 (201509)

Instructor

Dr. Yang Shi
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Office Hours

Days: Monday and Thursday
Time: 4PM-5PM
Location: EOW-519

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.

Syllabus

Lectures

A-Section(s): A01 / CRN 12317
Days: **Monday and Thursday**
Time: **2:30 pm-3:50 pm**

Labs

B –Section(s)	**Days**	**Time**	**Location**
B01	W	08:30 - 11:20 AM	**ELW B232**
B02	W	02:30 - 05:20 PM	**ELW B232**

Location: **ECS 125**	B03	R	04:00 - 06:50 PM	**ELW B232**
	B04	F	08:30 - 11:20 AM	**ELW B232**

Tutorials			
T – Section(s)	**Days**	**Time**	**Location**
T01	F	05:30 - 06:20 PM	**HSD A240**

- **Official Calendar Description**

  Modeling dynamic systems (linear systems and feedback control). Transfer function based analysis and design (transfer functions, root-locus, stability, transient responses). Frequency characteristics design methods (frequency responses, stability, gain and phase margins, system compensation). State-space design methods (state transition matrix, state feedback and shaping dynamic responses; linear observers).

- **Sequence of Topics** (may be subject to minor adjustments)

TOPIC	TIME IN WEEKS	CONCEPTS TO BE LEARNED
Linear System Models	2	Mathematical models of physical systems, transfer functions representation
Time Response and Stability	2	First and second order system responses, BIBO stability, Routh-Hurwitz stability criterion
Block Diagrams and Signal Flow Graphs	1	Block diagrams of systems, block diagram reduction, signal flow graphs of systems, Mason's formula
Feedback Control System Characteristics	2	Transient response, system specifications and performance analysis, and steady-state analysis
Dynamic Compensation	1	Feedback compensation, lead-lag compensation
Root Locus Analysis and Design	2	The root locus method, rules for root locus plotting and construction of root locus, root locus design
Frequency Response Analysis and Design	2	Frequency response, Bode plots and Nyquist diagrams, stability criterion, gain and phase margins, compensator design in the frequency domain

- **Teaching Assitants**

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Kunwu Zhang	kunwu@uvic.ca
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Required Text

Title: Control Systems Engineering, Sixth Edition

Optional Text

Title:

Author: Norman S. Nise
Publisher: Wiley
Year: 2010

Author:
Publisher:
Year:

References:

Assessment:

Assignments:	15%	Due Dates:
Labs	10%	
Mid-term	25%	Date:
Final Exam	50%	

Note:

- **Assignment**
  - 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.

- **Labs**

  There are three labs. The lab schedule is to be finalized soon.
  - All labs are conducted in ELW B232 during the schedule time by lab TAs.
  - 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 exactly 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.

- **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 the tutorial.

- **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 & Thursday 4PM-5PM

- **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 **TBD**, 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.

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.

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.

Accommodation of Religious Observance
See entry in current Undergraduate Calendar

Policy on Inclusivity and Diversity
See entry in current Undergraduate Calendar

Standards of Professional Behaviour

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour in current Undergraduate Calendar, which contains important information regarding conduct in courses, labs, and in the general use of facilities.

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

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.