Course Objectives
Learn to:
- design linear feedback control systems using frequency-domain and state-space methods
- analyze and verify the designs using MATLAB/Simulink

Prerequisites
ECE 4150 Control Systems

Course Content
The following topics will be covered:
- Review of time-domain response of second-order linear systems (transient and steady-state behaviors)
- Frequency-domain analysis techniques - Bode plots, Nyquist diagrams and stability criterion, phase and gain margin.
- Frequency domain compensator design techniques.
- Describing function method for systems with non-linearities.
- State space modeling and analysis of linear systems; controllability and observability.
- State-space design techniques (controller and observer design).

Accreditation Units
Mathematics: 0
Natural Science: 0
Complementary Studies: 0
Engineering Science: 40%
Engineering Design: 60%

Web Page
http://ece.eng.umanitoba.ca/undergraduate/ECE4160

Textbook

Evaluation Details
The final course grade is determined by the student’s performance on assignments, in laboratories, and on examinations. Students must complete all the laboratories in order to be eligible to receive a passing grade.

Mid-Term(s)
Term test 1, Wednesday, February 12, 2014 (6:00-8:00 PM) in E2-221
Term test 2, Thursday, March 13, 2014 (6:00-8:00 PM) in E2-221

Instructor
Prof. Pradeepa Yahampath
Room: E1-536 EITC
Telephone: (204) 474-8784
Email: pradeepa.yahampath@umanitoba.ca
Office Hours
Monday, Wednesday & Friday 11:30 AM – 12:30 PM or by appointment.

Teaching Assistants
TBA

Voluntary Withdrawal Date
Wednesday, March 19, 2014

Requirements/Regulations
- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.

Academic Integrity
Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism or any other form of cheating in examinations, assignments, laboratory reports or term tests is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty.
Learning Outcomes

2. Design lead, lag, and lag-lead compensators to meet a given set of performance specifications using frequency domain design techniques.
3. Analyze limit cycle oscillations and stability of control systems with non-linearities using the describing function method.
4. Analyze linear control systems using state-space concepts.
5. Design linear control systems using state-space methods.

**Expected Competency Level**

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<th>Learning Outcome</th>
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*Attributes:
A1 A knowledge base for engineering
A2 Problem analysis
A3 Investigation
A4 Design
A5 Use of engineering tools
A6 Individual and team work
A7 Communication skills
A8 Professionalism
A9 Impact of engineering on society/environment
A10 Ethics and equity
A11 Economics and project management
A12 Life-long learning

**Competency Levels:**
1 - Knowledge (Able to recall information)
2 - Comprehension (Able to rephrase information)
3 - Application (Able to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships)
5 - Synthesis (Able to combine separate elements into whole)
6 - Evaluation (Able to judge of the worth of something)

Student Contact Time (Hrs)

**Lectures:** 3 hrs lecture/week × 13 weeks/term = 39 hrs

**Laboratories:** 3 hrs laboratory × 5 weeks = 15 hrs

Evaluation

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<tr>
<th>Component</th>
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<th>Methods of Feedback</th>
<th>Learning Outcomes Evaluated</th>
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* Methods of Feedback: F - formative (written comments and/or oral discussion), S - summative (number grades)