WESTERN UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE 9507 (9057) – ADVANCED DIGITAL CONTROL SYSTEMS

COURSE OUTLINE – 2017

OBJECTIVE:
This course covers the design and analysis of discrete-time control systems (mainly model-based), suitable for implementation on digital computers. Both frequency-domain and time-domain methods are used to design digital control schemes that meet system performance criteria. The emphasis in this course is on approaches suitable for **discrete-time, state-space** models. Following an introduction to state-space modeling, the design of feedback control laws using pole placement, state observers, and optimal control for satisfying the principle of optimality are studied. Practical issues such as digital control of a continuous-time system and actuator constraints are also discussed.

INSTRUCTOR: Mehrdad R. Kermani, Ph.D., P.Eng.
TEB 367, 519-661-2111 ext. 81260, e-mail: mkermani@eng.uwo.ca
CONSULTATION HOURS: Monday 1:30-2:30PM

CONTACT HOURS: 3 lecture hours per week;

PREREQUISITES: ECE 3331a/b, ECE 3330a/b

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

TEXTBOOK:
1. M.S. Santina, A.R. Stubberud, G.H Hostetter, Digital Control System Design, 2nd Edition, Oxford University Press, 1994.

ADDITIONAL REFERENCES
2. Franklin, G.F., Powell, J.D., and Workman, M.L., "Digital Control of Dynamic Systems", 3rd editions, Addison-Wesley, 1998
3. Åström, K.J., and Wittenmark, B., "Computer-Controlled Systems: Theory and Design", 2nd edition, Prentice Hall, 1990

TOPICS:
- -Introduction to Advanced Digital Control
- -Discrete-Time Systems and the Z-Transformation
- -State-Space Description of Dynamic Systems
- -Controllability and Observability

-Pole Placement using State Feedback
-Full and Reduced Order Observers
-Quadratic Optimal Regulation
-Digital Control of Continuous-Time Systems

SPECIFIC LEARNING OBJECTIVES:

1. Students will develop an understanding of the state-space approach for linear systems and the notions of controllability and observability.
2. Students will be able to analyze and design digital controllers using transfer functions and state-space techniques.
3. Students will be able to convert representations of linear dynamical systems from continuous-time to discrete-time.
4. Students will be able to acquire experience in designing controllers for discrete-time linear systems.
5. Students will learn to design full- and reduced-order observers for discrete-time linear systems.

EVALUATION:

The final grade will be based on final examination and the project. The examination will be limited open book and no programmable calculators will be permitted. The weights for the components are shown below:

		Maximum Penalties *	
Component	**Weight**	**English**	**Presentation**
Assignment	5%	5%	5%
Project	45%	10%	10%
Final Examination	50%		

All works will be marked first for content after which a penalty not exceeding the maximum shown above may be applied for the lack of proficiency in English or presentation. All submitted works must be of professional quality and those that are illegible and disorganized will be returned for resubmission with penalties.

In accordance with the policy of the University, the grade assigned to all written and oral work presented in English shall take into account syntax, diction, grammar, and spelling. In addition, in the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of their profession.

PROJECT:

Students are required to complete a project that involves the design and analysis of a digital control system of their choice. The use of Matlab®/Simulink® environment is strongly recommended.

Final Examination:

Closed book exam. Necessary equations are provided **or** permitted on a crib sheet (will be discussed in class). No programmable calculators are allowed.

ATTENDANCE:

Any student who, in the opinion of the instructor is absent too frequently from class or laboratory

periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the department concerned, and with the permission of the Dean, the student will be barred from taking the regular examination in the course.

Absence Due to Illness or Other Circumstances:
Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented. The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices: Students may use laptops, tablet computers, or smart phones *only* to access the course OWL site during lectures and tutorials. No other electronic devices may be used at any time during lectures, tutorials, or examinations.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail Policy: Students are responsible for regularly checking their Western e-mail and notices posted on the course web site and making themselves aware of any information that is posted about the course.

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question

regarding an accommodation.

Support Services: Office of the Registrar, http://www.registrar.uwo.ca/
Student Development Centre, http://www.sdc.uwo.ca/
USC Student Support Services, http://westernusc.ca/services/

Students that are in emotional/mental distress should refer to Mental Health @ Western, http://www.uwo.ca/uwocom/mentalhealth/, for a complete list of options about how to obtain help.