

**The University of Western Ontario
Faculty of Engineering****DEPARTMENT OF CHEMICAL AND BIOCHEMICAL ENGINEERING****CBE 9424 – Computer Process Control****Course Outline 2014-2015**

The course covers some advanced topics in process control such as Multivariable Control and Digital Control Systems. An introduction to the fundamental concepts in process dynamics and control including the frequency response technique will be provided depending on the background of the participating students. Discrete Process Control Theory using z-transformation is covered and the design of digital controllers will be discussed. Time permitting, the identification of stochastic processes and the design of digital controllers for the stochastic processes will be introduced.

The general outcome of the course is to enable the students to:

- Develop computational skills to analyse the feedback control systems in a variety of configurations
- Develop tools for testing stability of the feedback control systems in the s-domain, frequency domain and z-domain
- Understand the dynamics of multivariate (MV) control systems
- Design feedback controllers for the MV systems based on decoupling
- Design digital controllers in the z-domain and implement them on a real time computer control system

Prerequisites:

An introductory course in Process Dynamics and Control
Graduate Student Status or permission of the department

Corequisites:

None

Antirequisites:

None

Contact Hours:

3 lecture hours, 0.5 course.

Instructor:

Dr. S. Rohani (TEB 469) E.mail srohani@uwo.ca
Graduate Coordinator: TEB 480

Recommended Text

“Process Dynamics and Control”, by Seborg, D.E., Edgar, T.F., and Mellichamp, D.A. and Doyle, F. J. (3rd Edition) John Wiley & Sons Inc. (2011)

Reference Texts:

“Feedback Control of Dynamic Systems”, G.F. Franklin et al., 4th edition, Addison Wesley, 2002
“Process Dynamics and Control”, by Seborg, D.E., Edgar, T.F., and Mellichamp, D.A. and Doyle, F. J. (3rd Edition) John Wiley & Sons Inc. (2011)

Project:

Students will work individually or in groups of two on a computer simulation project using Matlab/Simulink or LabView.

Units:

SI and British units will be used

Specific Learning Objectives:**Closed Loop Systems**

At the end of this topic, students will be able to:

- Understand how to manipulate closed loop block diagrams to calculate the overall transfer functions
- Understand PID control and the role integration in offset removal
- Analyse the effect of chemical process dead time on control quality
- Tune a PID controller by trial and error as well as by using other analytical methods
- Use Simulink/Matlab tools to develop closed loop tuning simulations

Stability in Laplace Domain

At the end of this topic, students will be able to:

- Understand the concept of characteristic equation and be able to calculate it for closed loop systems
- Apply stability criteria to analyse the stability of systems

Stability in Frequency Domain

At the end of this topic, students should be able to:

- Use Matlab to plot various frequency functions (Bode/Nyquist) for control systems with dead time
- Apply Bode/Nyquist stability criteria to processes with dead time
- Use frequency methods to tune controllers

Design of Digital Controller in the z-domain

At the end of this topic, students should be able to:

- Analyze digital controlled systems
- Apply the z-transform, its properties and application in the design of discrete controllers
- Develop the discrete transfer function of the digital PID controllers in the z-domain
- Analyze the stability of sampled-data systems
- Design model-based digital controllers

Multi Variable (MV) Transfer Functions

At the end of this topic, students will be able to:

- Develop a MV Transfer Function Matrix for a MV process
- Understand Relative Gain Array (RGA) for MV systems
- Design Decoupling Controllers

Stochastic Processes

At the end of this topic, students will be able to:

- Carry out offline and online identification of stochastic processes
- Design of minimum variance and generalized minimum variance controllers

Evaluation:

The Computer Process Control Laboratory has a number of processes interfaced to real time computers. A series of goals will be set for the group and a comprehensive project report will be used to assess the group and individual performance. Simulation projects using Matlab + Simulink are also available.

The final course mark will be determined as follows:

Assignments	20%
Computer Simulation Term Project	20%
Midterm Examination	20%
Final Examination	40%

Examination will be closed book. A formulae sheet is allowed.

Calculators of any kind will be permitted during examinations. **The memory of the calculators should be purged before the examination.**

Note: 1) Students must pass the final examination to pass this course. Students who fail the final examination will be assigned 48% if the aggregate mark is higher than 50%, or the aggregate mark.

2) Students must turn in all laboratory reports, and achieve a passing grade in the laboratory component, to pass this course. 3) Assignments are to be handed in the CBE 420 locker located in the Thompson Engineering Building, on the specified due date provided by the Instructor.

Use of English:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

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 Associate Chair (Graduate), after due warning has been given. On the recommendation of the Department concerned, and with permission of the Associate Chair, appropriate action will be taken, with the possibility of course failure.

Cheating:

University policy states that cheating is a scholastic offense. The commission of a scholastic offense is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

Plagiarism:

University policy states that plagiarism is a scholastic offense. Plagiarism is defined as appropriating and passing off writings or ideas of another person's as one's own. Penalties may include failure or automatic withdrawal from the course.

Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence

The University of Western Ontario has software for plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

For further information on plagiarism, consult the Scholastic Offence Policy in the Western Academic Calendar.

Sickness and Other Problems:

Students should immediately consult with the instructor or Associate Chair (Graduate) if they have any problems that could affect their performance in the course. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Notice:

Students are responsible for regularly checking their email and notices posted on Instructors' doors.

Consultation:

Office hours will be posted. Individual consultation may be arranged by appointment with the instructor.

Accreditation Unit (AU) Content:

Engineering Science	=	60%
Engineering Design	=	40%

November 26, 2014 sr