ChE 524 – WINTER 2015

PROCESS CONTROL LABORATORY

Course description:

Experiments on process dynamics, control and simulation of processes. Time constant; step and frequency response; controller tuning; multivariable control strategies. Implementation using simulation systems, mainframe computer control, microcomputers.

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Course Timetable:

Tutorial Session: Mondays from 10:30 to 11:20am in E6-4022.

Laboratories:

- Tuesdays from 8:30am to 11:20am in DWE-1513/1514.

- Thursdays from 3:30 p.m. to 6:20 p.m. in DWE-1513/1514.

Important Dates:

Laboratories will start on the second week of the term.

Reading Week: February 16th-20th, 2015 (Tutorial and Labs cancelled).

Short Quiz: Date, time and location TBA

Grading:

Lab Performance/Discussions	20 %
Final Laboratory Reports	50 %
Short Quiz	30 %

The laboratory reports and the short quiz will be marked by the teaching assistant and the course instructor.

Textbook:

Seborg, D.E., Edgar T.F. and Mellichamp, D.A. *Process Dynamics and Control*, John Wiley & Sons, Inc., Second Edition, 2004.

Course Topics:

- Traditional System Identification Methods for Process control.
- Internal Model Control, IMC.
- Model Predictive Control, MPC.
- Digital Sampling, Filtering and Control (z-transform).

Laboratories

- Double Heat Exchanger experiment (DPHE).
- Continuous Stirred Tank Heater experiment (CSTH).
- Multivariable flow, level, pressure and temperature control unit.

Each experiment consists of two sessions.

1st Session: System Identification.

- Read the following sections of the textbook:
    - CSTH experiment: Sections: 5.1, 5.2, 6.1, 6.2, 6.3, 7.1 and 7.2.
    - DPHE experiment: Sections: 5.1, 5.3, 6.2, 6.3, 6.5, 7.1, 7.2, 18.1 and 18.2
    - Multivariable experiment: single variable control, chapters 8, 9, 11 and 12.
- Perform data acquisition in the laboratory.

2nd Session: Controller testing.

- Submit a preliminary report one week before the second session. The preliminary report should include the following:
    - Results and observations from the data acquisition session.
    - Process model parameters and the fitting of the data to the models.
    - Feasibility region.
    - Design a controller for the experiment.
    - Propose a set-point tracking and load changes experiments for the controller testing session.
- Be prepared to give a five minute presentation followed by discussion of the results obtained from the first session.
- Read the following sections of the textbook:
    - CSTH: 8.1, 8.3, 8.5, 11.4, 12.3 and 12.4
    - DPHE: 20.1, 20.2, 20.3, 20.4 and 20.7
    - Multivariable experiment: multi-loop control, 18
- Perform control testing session on the laboratory.

Important: Bring a flash memory to the lab sessions to download your data and results.

Final Laboratory Report:

Report is due 2 weeks after the laboratory has been completed. The report should follow standard lab reporting format and should contain sections such as:

- Pertinent theory (½ – 1 page maximum).
- Experimental procedure if not outlined in manual, otherwise only list deviations from the specified procedure.
- System identification and Modelling (1st Session)
    - Results, not intended for in depth discussion, but should include:
        - Detailed modelling methodology for each "unique" case.
        - Model parameters obtained for each case.
        - Graphical summary of remaining modelling, clearly showing relevant information (i.e. data and models on the same plot for easy comparison)
    - Discussion of modelling and interpretation of results.
- Control Testing (2nd Session)
    - Results
        - Theoretical versus actual, same rules for plotting
    - Discussion
        - Explain discrepancies if possible
        - Evaluate controller qualitatively and quantitatively
        - Discuss actual versus theoretical performance with regard for "real world" implications.
- Conclusions
    - Discuss with focus on proposed objectives from preliminary report.
    - Unattained objectives ARE NOT penalized, but poor discussion is.

Marking scheme for the laboratory reports:

- Intro and formalities 5%
- Clarity of writing 5%
- Graphs and plots 10%
- Other formatting 5%
- System Identification and Modelling 25%

(Write-up and validity of modelling session)

- Controller testing 25%

(Write-up and explanations for second session)

- Conclusions and recommendations 25%

Preliminary laboratory schedule

TBA

Classroom Responsibilities:
http://www.eng.uwaterloo.ca/~ugoffice/course_responsibilities.html

Academic Integrity, Grievance, Discipline, Appeals and Note for Students with Disabilities: see www.uwaterloo.ca/accountability/documents/courseoutlinestmts.pdf The text for this web site is listed below:

Institutional-required statements for undergraduate course outlines approved by Senate Undergraduate Council, April 14, 2009

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline, http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals, http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for students with disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.