

## CM 3310 / Spring 2008

**Instructor:** Dr. Tomas Co ( ChemSci 202 G, Tel 487-2144, [tbc@mtu.edu](mailto:tbc@mtu.edu) )  
**Office Hrs:** Mon 11-12, 3-5, Wed 3-5  
**TA:** Cho Hui Lim ( [chlim@mtu.edu](mailto:chlim@mtu.edu) )

**Textbook:** B. Wayne Bequette, *Process Control, Modeling, Design and Simulation*, Prentice Hall, 2003

### Course Outline

#### I. Continuous Time Dynamics

##### Week 1

1. Introduction to process dynamics and control p 1-20
2. Process modelling p. 31-50
3. Solution of Ordinary Differential Equations
- a) Analytical solutions:  
eigenvalues, time constants, damping coefficients

##### Week 2

- b) Numerical solutions:  
Euler Method, Runge-Kutta Method
4. Empirical Models
5. Linearization p. 60-66

##### Week 3

6. PID Control
- a) Concepts (p.156-173)
- b) Analysis
- c) Performance
- d) Tuning Methods p. 198-209

##### Week 4

**Exam 1**

Week 5

**II. Laplace Transform Methods**

1. Basics
  - a) Definition and elementary transforms p.85-94
  - b) Method of Partial Fractions

Week 6

2. Transfer Functions p. 95-119
3. Block Diagram Manipulations

Week 7

4. Stability and Performance
5. Routh – Hurwitz Methods p. 173-177

Week 8

**Exam 2**

Week 9

6. Other control configurations
  - a) IMC p.263-269
  - b) Cascade p.313-323
  - c) Feedforward/Feedback p.324-333

Week 10

**III. Frequency Response Methods**

1. Frequency response experiments and data p. 216-219

Week 11

2. Bode and Nyquist Plots
  - a) elementary transfer functions p. 219-223
  - b) transfer functions in series p. 223

Week 12

3. Nyquist stability criterion p. 230-231

Week 13

4. Gain and phase margins p.231-232

Week 14

**Exam 3**

**IV. Advanced Topics (as time permits)**

- 7. Multivariable Control/RGA p.381-408
- 8. Model Predictive Control/ Dynamic Matrix Control p.487-506

REVIEW

Week 15

**FINALS**

**GRADING POLICY**

**Point Distribution**

|            |        |
|------------|--------|
| Projects   | 30 pts |
| Laboratory | 30 pts |
| Exam 1     | 10 pts |
| Exam 2     | 10 pts |
| Exam 3     | 10 pts |
| Finals     | 10 pts |

**Letter Grade Equivalence:**

|            |    |
|------------|----|
| 100 - 95   | A  |
| 94.99 - 90 | AB |
| 89.99 - 80 | B  |
| 79.99 - 70 | BC |
| 69.99 - 60 | C  |
| 59.99 - 55 | CD |
| 54.99 - 50 | D  |
| 49.99 - 0  | F  |

### **Additional Policies:**

1. Projects need to be done individually and submitted in the form of a brief report.
2. Deadlines on the projects will be enforced strictly. (Each day late means a 10 point deduction.)
3. All projects and exams should be neatly written on one side of an 8-1/2" by 11" paper and stapled together. The name and mailbox number should appear in the upper right corner of the front page. Failure to do so will mean a maximum of 3 pt. deduction.
4. Submit your projects in BOX A (opposite 2<sup>nd</sup> Floor elevators of the Chem Sci Bldg.)
5. Resubmission of projects will be allowed once on each project and only for those submitted on time. The due dates for resubmission will be determined upon return of the projects. The maximum grade allowed for resubmitted works will be 95% instead of 100%.
6. Exams can be taken earlier than the set time for the following reasons: a) time conflicts with other exams or courses, b) time conflicts with approved departmental activities, c) medical appointments, d) family emergencies. To be considered, write a memo at least three days prior to the set date of exam (except for case d) stating the reason for the request, including supporting attachments. If approved, we will mutually set a time suitable for maximizing the overlap of people taking the early exam. Everyone taking the exam early will be required to sign a form of non-disclosure of exam contents.
7. Taking exams later will be allowed only for those with pre-approved memos or memos with attachments of official documentation, e.g. letter from doctor for medical emergencies.
8. Attendance is required for the laboratory classes. For the lectures, attendance and participation are strongly encouraged.