

**UNIVERSITY OF MASSACHUSETTS
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING**

**ECE 580
MIE 444**

**FEEDBACK CONTROL SYSTEMS (I)
AUTOMATIC CONTROLS**

FALL, 2015

Class Hours: Tu-Th 2:30 PM – 3:45 PM

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Office Hours: Tu 4:00 – 5:00PM; W 3:00 – 5:00PM

Course Web Page: <https://moodle.umass.edu/> (login using OIT ID)

The moodle page contains all the course material to date, including this syllabus, the problem sets, and the lecture notes.

Textbook: Franklin, Powell and Emami-Naeini, *Feedback Control of Dynamic Systems*, 7th Edition, Prentice-Hall, 2015. (referred to as FPE)

References: Ogata, *Modern Control Engineering*, Prentice-Hall, 2009.
Nise, *Control Systems Engineering*, Wiley, 2015.
Dorf, *Modern Control Systems*, Prentice-Hall, 2008.

Exams: There will be one (2 hour) exam given during the semester and a final exam given during exam week. The midterm exam will be 30% of the course grade. The final exam will be worth 40% of the course grade.

Homework: There will be approximately 8 assignments which will be due at the beginning of the lecture on the specified date. **Late homework will not be accepted** – regardless of the reason. Homework will constitute 30% of the grade.

Objectives:

1. Understand and be able to represent dynamic response.
2. Understand the principles and objectives underlying feedback control, and how these affect the architecture of the control system.
3. Understand and be able to apply analysis tools to determine control system performance.
4. Design a feedback control system to achieve specified objectives..

Table 1. Relationship of Course Objectives to ABET EC2000 Program Outcomes

| ABET Outcome | Course Objectives | | | |
|---|-------------------|---|---|---|
| | 1 | 2 | 3 | 4 |
| a) Apply knowledge of math, science & engrg. | X | X | X | X |
| b) Design & conduct experiments; analyze & interpret data | | | X | |
| c) Design a system, component or process to meet desired needs | X | X | X | X |
| d) Function on multi-disciplinary teams | | | | |
| e) Identify, formulate, solve engineering problems | X | X | X | X |
| f) Understand professional, ethical responsibility | | | | |
| g) Ability to communicate effectively | | | | |
| h) Understand impact of engineering soln. in global & societal context | | | | |
| i) Need to continue life-long learning | | | | |
| j) Knowledge of contemporary issues | | | | |
| k) Ability to use techniques, skills and tools needed for engrg. practice | X | X | X | X |

OUTLINE

1. System response Review FPE Chapters 1–3 (1)*
 - a) Laplace Transforms
 - b) Time Response
 - c) Stability
 - d) Frequency response

2. Control System Objectives FPE Chapter 4.1–4.2 (3)
 - a) Potential for Control
 - b) Performance
 - i) Measures
 - ii) System type

3. Classic PID Control FPE Chapter 4.3 (3)
 - a) Proportional, Integral and Differential Elements
 - b) Effects on system response
 - c) PID tuning rules

4. Root locus FPE Chapter 5 (2)

5. Frequency Response Analysis FPE Chapter 6.1–6.4 (5)
 - a) Bode diagrams
 - b) Nyquist diagrams
 - c) Stability margins

5. Design of control systems FPE Chapter 6.6, 6-7, 8.1–8.3 (12)
 - a) Design objectives
 - b) Compensation techniques
 - c) Computer implementation

6. Exam (1)

* Approximate number of 75 min. lectures.