

Course Syllabus

ECE 7930/6930 - Special Topics in Electrical Engineering “Advanced Control Designs” Fall 2005, Independent Study Course.

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Office Hours: Friday 1:00 PM to 2:30 PM or by appointment.

Main Textbook:

- Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado “Control System Design” (Hardcover) Prentice Hall; Bk&CD-Rom edition (September 26, 2000) ISBN: 0139586539. 944 pages. Book web page <http://csd.newcastle.edu.au/>

Prerequisites:

- ECE/MAE 6320 “Linear Multivariable Control” or instructor’s approval.

Credits: 3

Course Load: 10 hours per week. 12 weeks.

Course Requirements:

4 Projects using Quanser platforms	40 points
1 Literature Survey Report: (The details will be sent via email.)	20 points

There is no Mid-term Exam and Final Exam.

Notes:

1. This course is designed for a normal semester (16 weeks) independent study.
2. To get 3 credits, you have to spend at least 120 hours in total in this course, although you have the *flexibility* to arrange your efforts.
3. A weekly discussion is encouraged (but not compulsory) in the Instructor’s office in the course office hour. Friday 1:00-2:30pm.
4. A weekly reading/experiment summary must be submitted via email.
5. More emphasis will be put on the advanced control design algorithms understanding and experimental verification in the lab using Quanser’s RTW platform
6. *Essential course materials will be given by the Instructor via emails.*

Course Description:

The goal of “Advanced Control Designs” is to lead the students, who want to further enhance their ability in systematic design of control systems beyond normal control courses offered at ECE Dept of USU using the great textbook by Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado.

Emphasis is put on the advanced control algorithms understanding and/or development with lab experiment verification.

The projects will be from the following options:

- **SISO systems**
 - Relay automatic tuning of PID controller design, performance assessment and PID controller re-design via relay feedback tests.
 - Feedforward compensation techniques, disturbance observer design
 - General IMC designs
 - Predictive controls
- **MIMO systems**
 - MIMO Model Predictive Control (MPC)
 - MIMO controller parameterization and optimization based controller design **(7930 level)**
 - Decoupling controller designs **(7930 level)**
 - Loopshaping designs **(7930 level)**
(http://public.cranfield.ac.uk/soe_staff/eh3081/lsdptool.html)

Lab experiment options

- Double rotary inverted pendulum
- Solar tracker
- Gyro/stable platform
- Heat flow experiment
- Coupled tank
- QET Engineering Training Kit

Lab facilities for this course

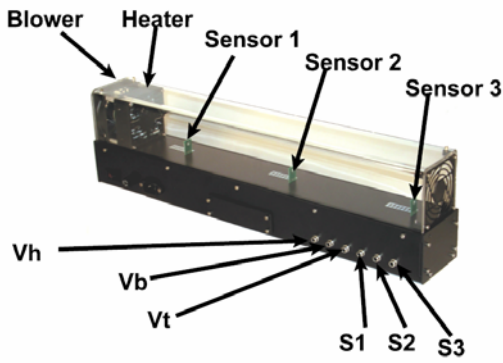
“*Mechatronics Lab*” was built on top of the existing “*Controls Lab*” (EL112). In this lab, mainly for undergraduate and graduate teaching purposes, there are 5 stations each equipped with a Quanser real time hardware-in-the-loop simulation system (Quanser MultiQ board + terminal board + SRV-ET DC motor + power amplifier). A whole family of Quanser Rotary Plants was purchased in the beginning of 2003 spring semester as shown in Figure 1.



Figure 1. Quanser rotary family mechatronic plants

In Spring 2005, we acquired some more mechatronics plant to make the mechatronics design projects more diversified and attractive, these new equipments are show in Figure 2.

Other instruments include standard multimeters, function generators, oscilloscopes, soldering stations etc. Additionally, we have some other plants installed such fan and plate system, water tank level control system, coupled tank system, etc. We also have 6 GP-6 analog computers perfect for signal conditioning and for plant simulated plants, shown in Figure 3.



(a) Heat flow experiments



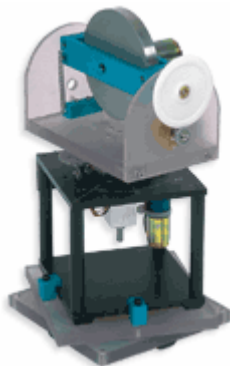
(b) QET Engineering Training Kit



(c) Solar tracker



(d) Mechatronic Control Kit



(e) Gyro/stable platform



(f) double rotary inverted pendulum

Figure 2. Some extra mechatronic plants in the PI's mechatronics lab.



Figure 3. GP-6 analog computer (<http://www.comdyna.com/gp6intro.htm>)