Tentative Syllabus: Spring 2011
Automated Control Systems II (EET K266)
Prof. Rhoades

This course is dual-listed with the Manufacturing Engineering Technology program, and has been run in two segments in the past. I will again be covering both segments including the Mechatronics segment originally developed by Prof. Patrick Knowles of MET.

I will run the lecture course in logical order with the Mechatronics segment first, from 1/24/11 to about 3/21/11. This includes lab setups using NI ELVIS virtual instrumentation on the LabVIEW platform. The Programmable Logic Controller (PLC) segment follows from about 3/23/11 to 5/16/11.

I plan to begin with a brief review of the basics of closed-loop controllers, including the proportional, integral, and derivative control modes and combinations. This is the basis of the current industry standard, the PID (or three-mode) controller.

Mechatronics is a cross-disciplinary field combining mechanical devices and electronics. This would cover the actuators and sensors of feedback control systems, including classical analog systems, digitized systems, and PLCs. Some of the lab material has already been integrated into the NI ELVIS environment, and some additional changes may occur this term.

The Programmable Logic Controller was originally developed as a rugged industrial computer that simulated the older relay-ladder logic. We will be teaching the ladder-program approach to programming the PLC since it is a graphic user interface (GUI) that is more easily grasped than some of the other programming methods. PLCs can be found in nearly all manufacturing plants.

Office: Room C232 MW 3:00 p.m.-12:00 p.m., T 4:00-4:50 p.m..

Class: Mondays and Wednesdays 4:00-5:15 p.m., Room D228
(no class on 2/21, Presidents Day, or 3/14 & 3/16, Spring Break).

Lab: Thursdays 10:00-11:40 a.m., Room B229 and Room D117 (see syllabus).

Text: (1) Christopher T. Kilian, *Modern Control Technology*, 3rd edition. This was the Automated Controls I text.
(2) David A. Geller, *Programmable Controllers Using the Allen-Bradley SLC-500 Family,* 2nd edition. This will be used after midterm.

Tests: Tests count 85% of the course grade, probably three.

Paper: A research paper will be assigned, worth 10% of the course grade.

Homework: Worth 5% of the grade. A few assignments will be collected, unannounced, for assessment. Also, each student, at random, will present the solution to a selected problem before the instructor's solution is revealed.

Tentative Syllabus: Spring 2011
Automated Control Systems II: Mechatronics Segment
Prof. Rhoades

This segment runs from 1/24/11 to about 3/21/11. Text: Kilian.

Seq.	Topic	Text Chapter	Chapter Sections	Comments
I.	Closed-Loop Control	11	Intro, 1, 3-6	Modes of control and the PID controller. Handout will demonstrate ad-hoc PID tuning.
II.	Additional Sensors	6	4-9	Kilian section 3 (proximity sensors) will be used in the PLC segment.
III.	Stepper Motors and Related Devices	(7) (9) 8 **Test 1?**	(6) (1-2) Intro, 1-3	Brushless DC motor, Three-phase AC motor, Stepper motors main topic.
IV.	Actuators	10	Intro, 1-3	Linear motion: Electric cylinder, linear motor & solenoid; pump-based and static hydraulic systems; pneumatic systems.

Tentative Syllabus: Spring 2011
Automated Control Systems II: PLC Segment
Prof. Rhoades

This segment runs from about 3/23/11 to 5/16/11. Text: Geller.

Seq.	Topic	Text Chapter	Comments
I.	Digital Review	1	Use as a self-test. Note new topic: Dotted-decimal notation
II.	I/O Wiring	2	I/O Device Symbols PLC I/O Module Types Wiring Considerations
III.	Input Devices	3	Overview and practicalities: Cross-reference material to Kilian Sect. 4.3.
IV.	Ladder Rung Logic	4 **Test 2?**	Full Control (Energize) Half Control (Latch/Unlatch)
V.	Equipment Sample	4	Ladder program development techniques by example.
VI.	Allen-Bradley PLC Structure	5	PLC Models Program and Run Modes I/O and Program Scans File Structure and Addressing
VII.	Design/Development	6, 7	Overview only. RSLogix-500 in lab.
VIII.	Basic Control	8	Additional hardware and examples
IX.	Timers and Counters	9, 10	Files and applications
X.	Logic/Math/Files	11	Selected Topics
XI.	Shift Registers	14 **Test 3**	BSL and BSR only. Bit files.

Course Outcomes

ABET Outcome Requirements

a) an appropriate mastery of the knowledge, techniques, skills, and modern tools of their disciplines
b) an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology
c) an ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes
d) an ability to apply creativity in the design of systems, components, or processes appropriate to program educational objectives
e) an ability to function effectively on teams
f) an ability to identify, analyze and solve technical problems
g) an ability to communicate effectively
h) a recognition of the need for, and an ability to engage in lifelong learning
i) an ability to understand professional, ethical and social responsibilities
j) a respect for diversity and a knowledge of contemporary professional, societal and global issues
k) a commitment to quality, timeliness, and continuous improvement

TRCC EET Stated Outcomes

1. Students will practice the skills needed to work effectively in teams and as an individual.
2. Students will demonstrate the ability to use appropriate mathematical and computational skills needed for engineering technology applications.
3. Students will combine oral, graphical, and written communication skills to present and exchange information effectively and to direct technical activities.
4. Students will know of a professional code of ethics.
5. Students will describe concepts relating to quality, timeliness, and continuous improvement.
6. Students will describe how the concepts of electric circuits, electrical measurements, digital electronic devices, programmable logic circuits, electromechanical and automated systems, affect the design, maintenance, and operation of electrical systems.
7. Students will illustrate an ability to think critically and identify, evaluate and solve complex technical and non-technical problems; demonstrate creativity in designing problem solutions; and conduct and interpret experimental data and outcomes.
8. Students will recognize actions and acts of professionalism that allows them to become informed and participating citizens cognizant of ethics, civic duty, and social responsibility.
9. Students will recognize the need to be lifelong learners.

K266/7 Course Outcomes

1. Mastery of Electrical Technology concepts as defined in the course syllabus
2. Knowledge of concepts of closed-loop control systems and related sensors and actuators
3. Demonstrate an ability to build and test circuits and systems related to control systems
4. Demonstrate an ability to analyze and solve problems related to closed-loop control systems
5. Demonstrate senior level oral and written communication skills
6. Demonstrate an appreciation for lifelong learning
7. Demonstrate proper professional and ethical behavior
8. Demonstrate a commitment to quality, timeliness and continuous improvement

Tentative Syllabus: Spring 2011
Automated Control Systems II Lab (EET K267)
Prof. Rhoades

Week	Date	Location	Title
L1	1/20/11	B229	Miscellaneous Mechatronic Sensors
L2	*2/10/11*	D117	Introduction to NI ELVIS
L3	*2/17/11*	↓	LabVIEW Virtual Instruments (2 wks)
L4	*2/24/10*	↓	↓
L5	*3/3/10*	TBD	TBD (Closed-Loop Motor Control)
L6	*3/10/11*	↓	↓
L7	*3/24/11*	D117	Introduction to the PLC
L8	*3/31/11*	↓	Full-Control and Half-Control Ladder Rungs
L9	*4/7/11*	↓	The Mercury Robot
L10	*4/14/11*	↓	The Chemical Plant
L11	*4/21/11*	↓	Timers and Counters
L12	*4/28/11*	↓	Shift Registers
L13	*5/5/11*	↓	Math and Logic Instructions
L14	*5/12/11*	↓	Analog I/O Modules
L15	*TBD*	–	Makeups

Rev. 2/22/11

Backup of previous list

Week	Date	Location	Title
L1	1/20/11	B229	DC Motor/Tach and Open-loop Controller
L2	1/28/10	↓	Closed-loop motor speed control
L3	2/11/10	↓	Miscellaneous Mechatronic Sensors
L4	2/18/10	D117	Introduction to NI ELVIS
L5	2/25/10	↓	LabVIEW Virtual Instruments (2 wks)
L6	3/4/10	↓	↓
L7	3/18/10	D117	Introduction to the PLC
L8	3/25/10	↓	Full-Control and Half-Control Ladder Rungs
L9	4/1/10	↓	The Mercury Robot
L10	4/8/10	↓	The Chemical Plant
L11	4/15/10	↓	Timers and Counters
L12	4/22/10	↓	Shift Registers
L13	4/29/10	↓	Math and Logic Instructions
L14	5/6/10	↓	Analog I/O Modules
L15	5/13/10	–	Makeups