Tentative Syllabus: Spring 2012
Advanced Control Systems
Prof. Rhoades, Prof. Courtney

This course is dual-listed with the Manufacturing Engineering Technology program, and its predecessor has been run in two segments in the past. We will again be covering both segments including the Mechatronics segment originally developed by Prof. Patrick Knowles of MET. This will be team-taught with Professor Rhoades the lead for both lecture and lab components, and lecture vs. lab distinctions may blur.

We will run the lecture course in logical order with the Mechatronics segment first, from 1/19/12 to about 3/15/12. This includes lab setups using NI ELVIS virtual instrumentation on the LabVIEW platform. The Programmable Logic Controller (PLC) segment follows from about 3/29/12 to 5/10/12. Besides the topics listed here, Prof. Courtney will give a series of short talks on robotics.

We 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. We have some brand-new trainer setups.

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: Rhoades – Room C232, M 4:00-5:00 p.m., T&Th 1:30-2:30 p.m.,
Courtney – Room C134 as posted.

Class: Thursdays 5:00-7:45 p.m., Room E223
(no class on 2/2, College Professional Day, or 3/22, Spring Break).

Lab: Thursdays 7:46-9:25 p.m., Room B229 and Room D117 (see syllabus).

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

Basis of Course Grade

Tests: Test results will be part of the course grade, probably three tests as shown above. A weighted-average system will be used.

Project: A project will be assigned as part of the course grade. This semester, the class will split up and investigate various new items of equipment. The results will be formally presented to the class later in the semester.

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

Portfolio: This is described separately. Portfolio evaluation is part of the final grade.

Lab Grade: This will be based largely on the submitted lab reports (either individual or group reports are acceptable), although attendance, punctuality, teamwork, etc. are also factors here. Note that since the projects and labs overlap, the same grade will be submitted to the registrar for both lecture and lab.

Academic Honesty

Students are expected to follow College policy on Academic Honesty regarding assignments. Specifically, be aware of the difference between collaboration and copying and be careful to cite sources when required. This policy also includes expectation of regular class attendance, punctuality, and timeliness in completing assignments.

Expectation of Civility and Safety

College policies for civility and safety are posted around the building. These must be followed in order to maintain a positive learning environment.

College Withdrawal Policy

Students may withdraw, in writing or verbally at the Registrar's Office for any reason until the end of the 10th week of classes. From the 11th week through the end of the 13th week, a student may withdraw with the instructor's written approval.

Disabilities Statement

If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact the Disabilities Counseling Services at 383-5240. To avoid any delay in the receipt of accommodations, you should contact the counselor as soon as possible. Please note that we cannot provide accommodations based upon disability until we have received an accommodation letter from the Disabilities Counselor.

Tentative Syllabus: Spring 2012
Advanced Control Systems: Mechatronics Segment
Prof. Rhoades, Prof. Courtney

This segment runs from 1/19/12 to about 3/15/12. 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.	Sensors	6	1-2, 4-9	Kilian section 3 (proximity sensors) will be used in the PLC segment.
III.	Motors, Stepper Motors and Related Devices	7 9 8 **Test 1?**	1-3, 6 1-2 Intro, 1-3	DC motor, Brushless DC motor, Three-phase AC motor, Stepper motors.
IV.	Actuators	10	Intro, 1-3	Linear motion: Electric cylinder, linear motor & solenoid; pump-based and static hydraulic systems; pneumatic systems.

Tentative Syllabus: Spring 2012
Advanced Control Systems: PLC Segment
Prof. Rhoades

This segment runs from about 3/29/12 to 5/10/12. 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– Associate Degree Programs - 2011/2012

a. an ability to apply the knowledge, techniques, skills, and modern tools of the discipline to narrowly defined engineering technology activities;
b. an ability to apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require limited application of principles but extensive practical knowledge;
c. an ability to conduct standard tests and measurements, and to conduct, analyze, and interpret experiments;
d. an ability to function effectively as a member of a technical team;
e. an ability to identify, analyze, and solve narrowly defined engineering technology problems;
f. an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature;
g. an understanding of the need for and an ability to engage in self-directed continuing professional development;
h. an understanding of and a commitment to address professional and ethical responsibilities, including a respect for diversity; and
i. 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 2012
Advanced Control Systems Lab
Prof. Rhoades

Week	Date	Location	Title
L1	1/19/12	D117	This portion has been used for mechatronics and LabVIEW/ELVIS experiments in the past. This semester, much new equipment in these areas has been acquired, so this time will be used for experimental work needed for student projects. Therefore, this semester these weeks are unstructured time. The results of the student projects will be evaluated to generate a series of investigations for future semesters.
L2	1/26/12	↓	
L3	2/9/12	↓	
L4	2/16/12	D117/B229	
L5	2/23/12	↓	
L6	3/1/12	↓	
L7	3/8/12	↓	
L8	3/15/12	↓	
L9	3/29/12	D117	Introduction to the PLC
L10	4/5/12	↓	Full-Control and Half-Control Ladder Rungs
L11	4/12/12	↓	The Mercury Robot
L12	4/19/12	↓	Timers and Counters
L13	4/26/12	↓	Math and Logic Instructions
L14	5/3/12	↓	Analog I/O Modules
L15	5/10/12	–	Makeups