C A M O S U N C O L L E G E

ELECTRONICS ENGINEERING DEPARTMENT

(ECET 280)

COURSE OUTLINE

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CALENDAR DESCRIPTION

ECET 280 Data Acquisition & Programmable Logic Controllers

This course offers a comprehensive study of data acquisition (DAQ) systems including: sampling theory, aliasing, time and frequency domains representation, anti-aliasing and recovery filter design, sample-and-hold (S/H) techniques, quantization theory, analog-to-digital (A/D) and digital-to-analog (D/A) converters, and the virtual instrumentation software LabVIEW. This course also covers major topics of programmable logic controllers (PLCs) including: PLC addressing and basic instructions, PLC Ladder logic, PLC timer and counter functions, PLC comparison and math operations, data handling and program flow control.

OFFERED:	Semester 3 (fall)
CREDIT:	3
IN-CLASS WORKLOAD:	3 lecture, 2.5 lab /week
OUT-OF-CLASS WORKLOAD:	6 hours /week
PREREQUISITES:	ECET 165

OBJECTIVE

- Be able to critique Data Acquisition (DAQ) systems in following aspects: signal acquiring, signal conditioning, and signal digitizing.
- Be able to use programmable logic controllers (PLCs)
- Be able to program the virtual instrumentation software LabVIEW

TABLE OF CONTENTS

Part I Data Acquisition Systems

1. Introduction to Data Acquisition (DAQ) systems **2 hours**
- 1.1. DAQ, DDS and "pure" computer systems
- 1.2. Five stages of a DAQ system
- 1.3. Relationships between stages
- 1.4. DSP applications in DAQ systems

2. Signal Conditioning and sample-hold circuits **8 hours**
- 2.1. Introduction to Signal Conditioning
- 2.2. Anti-aliasing and reconstruction filters
- 2.3. Switched capacitor filters
- 2.4. Sampling theory
- 2.5. Sample-hold circuit design

3. Analog-to-Digital (A/D) converters and Digital-to-Analog (D/A) converters 8 hours
- 3.1. Quantization theory
- 3.2. Digital-to-analog (D/A) converters
- 3.3. Analog-to-digital (A/D) converters
- 3.4. The frequency relationship between A/D converters and S/H circuits
- 3.5. A/D and D/A circuits design
- 3.6. Voltage-to-frequency (V/F) and frequency-to-voltage (F/V) converters

4. Instrumentation *(selective)* **6 hours**
- 4.1. Review of transducers and signal conditioning
- 4.2. Voltage references
- 4.3. Analog multiplexers and demultiplexers
- 4.4. Field wiring: shielding, grounding and noise considerations
- 4.5. Errors in data acquisition systems
- 4.6. DAQ systems specification
- 4.7. Examples of DAQ systems design
- 4.8. Over-sampling versus under-sampling

Part II Laboratory Virtual Instrument Engineering Workbench (LabVIEW)

5. Introduction to LabVIEW *(to be done in the lab)* **2 hours**
- 5.1. What is LabVIEW
- 5.2. LabVIEW control panels, block diagrams, and tools
- 5.3. LabVIEW functions and subroutines (sub-vi)
- 5.4. LabVIEW Serial communication and network communication

Part III Programmable Logic Controllers (PLCs)

6. Introduction to PLCs **2 hours**
- 6.1. What are PLCs
- 6.2. Input/output devices
- 6.3. PLC hardware – Allen-Bradley controllers
- 6.4. PLC software – LogixPro 500 and RSLogix 500

7. PLC addressing and basic instructions **2 hours**
- 7.1. Allen-Bradley PLC addressing
- 7.2. Basic input/output instructions
- 7.3. Branches

8. Ladder logic programming **4 hours**
- 8.1. Boolean statements and Ladder logic equivalents
- 8.2. Commonly used ladder logic sequences
- 8.3. Properly formatted outputs
- 8.4. Boolean logic and truth table review

9. PLC functions and operations **8 hours**
- 9.1. Timers
- 9.2. Counters
- 9.3. Math instructions
- 9.4. Comparison
- 9.5. Data handling
- 9.6. Program flow control
- 9.7. Bit shifts and Sequencer

TEXTBOOKS AND REFERENCES

1. Max Rabiee, **Programmable Logic Controllers**: Hardware and Programming, 3rd Edition, G-W Publisher, ISBN: 978-1-60525-945-1
2. James A. Rehg, Glenn J. Sartori: **Programmable Logic Controllers**, 2nd Edition, Pearson Education Limited, ISBN: 978-0-13-504881-8
3. ECET 280 Course Notes
4. Instructor's handouts
5. Manufacturers' datasheets

LABORATORIES

1. LabVIEW (I) – Introduction to LabVIEW
2. LabVIEW (II) – Functions and Sub-VI
3. LabVIEW (III) – DataSocket and Serial Communication
4. Anti-aliasing filter
5. Sample-and-hold circuit
6. Digital-to-analog converter
7. Analog-to-digital converter
8. PLCs (I) – Introduction to LogixPro 500 PLC Simulator
9. PLCs (II) – Garage Door Control
10. PLCs (III) – Silo system
11. PLCs (IV) – Traffic control
12. PLCs (V) – Introduction to Allen-Bradley PLCs and RSLogix 500
13. PLCs (VI) – Analog I/O modules (MicroLogix 1200)
14. PLCs (VII) – PWM/PID control (MicroLogix 1200)

EVALUATION

- Labs 20%
- Assignments and Quizzes 20%
- Midterm Exam 20%
- Final Exam 40%

GRADING In accordance with College policy

Letter Grades:

A+	90 – 100%	**B-**	70 - 72%
A	85 - 89%	**C+**	65 – 69%
A-	80 - 84%	**C**	60 - 64%
B+	77 - 79%	**D**	50 - 59%
B	73 - 76%	**F**	0 - 49%

A minimum of 50% must be achieved in each of the theory and lab portions to pass the course. Less than 50% in either portion will result in a failure of the entire course.

Note:

- Lab and lecture portions MUST be passed individually.
- Late penalties of 10% per day will be applied at the instructor's discretion.
- Lab attendance is MANDATORY. Failure to attend sufficient labs will result in an F grade.
- Lab grades will not be awarded for missed labs without a valid reason for absence.