

STATE UNIVERSITY OF NEW YORK  
COLLEGE OF TECHNOLOGY  
CANTON, NEW YORK



MASTER SYLLABUS

ELEC 243 – COMPUTER AUTOMATED CONTROL SYSTEMS

Prepared By: Robert Jennings  
Updated By: Dr. Stephen Frempong

CANINO SCHOOL OF ENGINEERING TECHNOLOGY  
ELECTRICAL ENGINEERING TECHNOLOGY AND ENGINEERING SCIENCE  
DEPARTMENT  
FALL 2023

A. **TITLE:** Automated Control Systems

B. **COURSE NUMBER:** ELEC 243

C. **CREDIT HOURS:** (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)

# Credit Hours: 2

# Lecture Hours: 1 per week

# Lab Hours: 2 per week

Other: per week

Course Length: 15 Weeks

D. **WRITING INTENSIVE COURSE:** NO.

E. **GER CATEGORY:** NONE

F. **SEMESTER(S) OFFERED:** Spring

G. **COURSE DESCRIPTION:**

An introduction to some of the control software systems in use in industry. The student is introduced to the architecture of the Arduino platform using the ATmega328P Microcontroller to the extent that various control functions can be identified and modified. Memory addressed I/O and the relationship of memory location access (analog and digital) by an Arduino microcontroller program.

H. **PRE-REQUISITES:**

a. **Pre-requisite(s):** [ELEC 231] Electronic Circuits, [ELEC141] Industrial Controls, and [ELEC213] Microprocessors or permission of the instructor.

b. **Co-requisite(s):** None

c. **pre-or co-requisite(s):**

I. **STUDENT LEARNING OUTCOMES:**

<b><u>Course Objectives</u></b>	<b><u>ABET-Student Outcomes (1-5)</u></b>	<b><u>Institutional SLO's</u></b>
a. Become familiar with the Arduino microcontroller platform.	(1) An ability to apply knowledge, techniques, skills, and modern tools of mathematics, science, engineering, and technology to solve broadly-defined	(5) Industry, Professional, Discipline-Specific Knowledge and Skills.

	engineering problems appropriate to discipline;	
<b>b. Understand the techniques to create software to communicate with the Digital input and output ports on the Arduino microcontroller</b>	(4) An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes;	(2) Critical Thinking  (5) Industry, Professional, Discipline-Specific Knowledge and Skills.
<b>c. Be able to develop Direct Current (DC) motor control programs and circuitry to provide speed control using Pulse Width Modulation.</b>	(4) An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes;	(2) Critical Thinking  (5) Industry, Professional, Discipline-Specific Knowledge and Skills.
<b>d. Be able to develop programs to implement a digital voltmeter with a PC Screen Display using an external analog to digital conversion chip.</b>	(4) An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes;	(2) Critical Thinking  (5) Industry, Professional, Discipline-Specific Knowledge and Skills.
<b>e. Be able to develop programs to provide real time digitally controlled outputs for positioning, speed and direction control of Stepper Motors.</b>	(4) An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes;	(2) Critical Thinking  (5) Industry, Professional, Discipline-Specific Knowledge and Skills.

<b>KEY</b>	<b><u>Institutional Student Learning Outcomes</u></b> <b><u>[ISLO 1 – 5]</u></b>
<b>ISLO #</b>	<b>ISLO &amp; Subsets</b>
<b>1</b>	<b>Communication Skills</b> Oral [O], Written [W]

2	<b>Critical Thinking</b> <i>Critical Analysis [CA], Inquiry &amp; Analysis [IA] , Problem Solving [PS]</i>
3	<b>Foundational Skills</b> <i>Information Management [IM], Quantitative Lit./Reasoning [QTR]</i>
4	<b>Social Responsibility</b> <i>Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]</i>
5	<b>Industry, Professional, Discipline Specific Knowledge and Skills</b>

J. **APPLIED LEARNING COMPONENT:**

Yes ☒ No ☐

If Yes, select one or more of the following categories:

Classroom/Lab ☒  
 Internship ☐  
 Clinical Practicum ☐  
 Practicum ☐  
 Service Learning ☐  
 Community Service ☐

Civic Engagement ☐  
 Creative Works/Senior Project ☐  
 Research ☐  
 Entrepreneurship ☐  
 (program, class, project)

K. **TEXTBOOK:** Blum, Richard, *Sams Teach Yourself Arduino Programing in 24 hours*.  
 Pearson, 2014, ISBN-13: 978-0-672-33712-3

L. **REFERENCES:** As specified by the instructor.

M. **EQUIPMENT:** As specified by the instructor.

N. **GRADING METHOD:** A-F

O. **SUGGESTED MEASUREMENT CRITERIA/METHODS:**

- Exams
- Quizzes
- Graded Laboratory Report
- Laboratory Practicum

P. **DETAILED COURSE OUTLINE:**

## I. Introduction to the Arduino platform using the AT mega 328P microcontroller

- A. Device Overview
- B. Pin Diagram
- C. Memory Organization
  - 1. Program Memory Organization
  - 2. Data Memory Organization
  - 3. Special Function Registers
  - 4. I/O Ports
  - 5. Addressing: Words and Bit
- D. Structured Programming
  - 1. Initialization
  - 2. Use of subroutines to “Section” or “Block” program
  - 3. Flow Charting
  - 4. Sequential Execution of code

## II. Introduction to Arduino platform using the ATmega 328P microcontroller /Lab Board

- A. System Connections
  - 1. Schematic
  - 2. Ports
  - 3. Addressing
- B. Input/Output Lines
  - 1. Digit
  - 2. Analog

## III. Digital Input/output

- A. Digital input test program, reading ports.
- B. Digital output test program, writing to ports.
- C. PIC Basic Input and Output Commands
- D. Digital circuit interface.

## IV. Combined Digital/Analog Applications

- A. DC Motor Speed Control using Pulse Width Modulation
- B. Digital Voltmeter with a On Screen Display
- C. Positioning, speed and direction control of Stepper Motors.

## Q. **LABORATORY OUTLINE**

NOTE: Some of the experiments in this laboratory are very lengthy and complex,

will require two weeks for completion.

#### EXPERIMENT TITLE

1. Introduction to Arduino platform using the AT mega 328P microcontroller URO board. Sample Blink program. Digital Outputs.
2. Structured Basic Sample Programs. Reading Digital Inputs.
3. BCD encoder and pulse width modulated variable speed DC Motor Drive. (2 weeks)
4. DC Motor Drive Sequencer Control System. (2 weeks)
5. Laboratory Practical Exam
6. Analog to Digital Conversion, digital voltmeter. (2 weeks)
7. Stepper Motors: Positioning, Speed, and Direction control. (2 weeks)
8. Laboratory Practical Exam