COURSE OUTLINE

ELEC 243 – COMPUTER AUTOMATED CONTROL SYSTEMS

Prepared By: Robert Jennings
A. **TITLE:** Computer Automated Control Systems

B. **COURSE NUMBER:** ELEC 243

C. **CREDIT HOURS:** 2

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

E. **COURSE LENGTH:** 15 weeks

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

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:** 1 hour lecture, 3 hours laboratory per week

H. **CATALOG DESCRIPTION:** An introduction to some of the control hardware/software systems in use in industry today. The student is introduced to the architecture of the Arduino platform using the ATmega 328P microcontroller to the extent that various control functions can be identified and modified. Programs are developed for computer interfaces for motor -control circuits to provide speed control using the Pulse Width Modulation technique. Programs for stepper motor interfaces are also developed. Programs are written to implement a digital voltmeter with a PC screen display.

I. **PRE-REQUISITES/CO-COURSES:**
   Pre-Requisites: Electronic Circuits (ELEC 231), Microprocessors (ELEC 213), and Industrial Controls (ELEC 141) or permission of the instructor.

J. **GOALS (STUDENT LEARNING OUTCOMES):**

   By the end of this course, seventy percent of the students will be able to:

<table>
<thead>
<tr>
<th>Course Objectives (STUDENT LEARNING OUTCOMES)</th>
<th>*Institutional SLO</th>
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<tbody>
<tr>
<td>1. Create software to communicate with the Digital input and output ports on the ATmega 328P microcontroller</td>
<td>2. Crit. Thinking</td>
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<tr>
<td>2. Create software to develop Direct Current (DC) motor control programs and circuitry to provide speed control using Pulse Width Modulation.</td>
<td>3. Prof. Competence</td>
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<td>3. Create a program to sequence motor operations based on input commands.</td>
<td>2. Crit. Thinking</td>
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<td>4. Create a program to implement a digital voltmeter with a PC screen display.</td>
<td>3. Prof. Competence</td>
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*Intuitional Student Learning Objectives (SLO):*

(1) Communication  (2) Critical Thinking (3) Professional Competence
(4) Inter-Intrapersonal Skills

K. **TEXT:**

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

M. **EQUIPMENT:** Arduino OSEPP Uno R3 Plus board with ATmega 328P microcontroller

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

O. **MEASUREMENT CRITERIA/METHODS:**
   • Quizzes
   • Graded Laboratory Reports
   • Laboratory Practicums

P. **DETAILED LECTURE OUTLINE:**
   See attached Detailed Lecture Outline on Page 4

Q. **LABORATORY OUTLINE:**
   See attached Laboratory Outline on Page 5
I. Introduction of the Arduino microcontroller architecture and introduction to the ATmega 328P microcontroller

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

II. Digital Input/output

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

III. Combined Digital/Analog Applications

   A. DC Motor Speed Control using Pulse Width Modulation
   B. Sequence motor operations based on input commands
   C. Digital Voltmeter with PC Display
   D. Control of Stepper Motors.
NOTE: Some of the experiments in this laboratory are very lengthy and complex and will require additional lab periods for completion

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<tr>
<th>EXP NO.</th>
<th>EXPERIMENT TITLE</th>
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<tbody>
<tr>
<td>1.</td>
<td>Introduction to the Arduino OSEPP Uno R3 Plus board with the ATmega 328P Microcontroller. Sample Blink program with Digital Outputs.</td>
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<td>2.</td>
<td>Structured Programs. Reading Digital Inputs and generating required outputs</td>
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<td>3.</td>
<td>BCD encoder and Pulse Width Modulated variable speed DC Motor Drive. (2 Weeks)</td>
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<td>4.</td>
<td>DC Motor Drive Sequencer Control System. (2 weeks)</td>
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<td>5.</td>
<td>Laboratory Practical Exam</td>
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<td>6.</td>
<td>Introduction to the Serial data display using the PC monitor</td>
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<td>7.</td>
<td>Using Analog to Digital Conversion techniques to implement a digital voltmeter. (2 weeks)</td>
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<td>8.</td>
<td>Stepper Motors: Speed and Direction control. (2 weeks)</td>
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<tr>
<td>9.</td>
<td>Laboratory Practical Exam</td>
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