ELEC 54C Course Outline as of Fall 2024

CATALOG INFORMATION

Dept and Nbr: ELEC 54C Title: MICROCONTROLLERS
Full Title: Microcontrollers and Embedded Systems
Last Reviewed: 8/14/2023

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	3.00	Lecture Scheduled	2.00	17.5	Lecture Scheduled	35.00
Minimum	3.00	Lab Scheduled	3.00	8	Lab Scheduled	52.50
		Contact DHR	0		Contact DHR	0
		Contact Total	5.00		Contact Total	87.50
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 70.00 Total Student Learning Hours: 157.50

Title 5 Category:	AA Degree Applicable
Grading:	Grade Only
Repeatability:	00 - Two Repeats if Grade was D, F, NC, or NP
Also Listed As:	
Formerly:	

Catalog Description:
In this course students will be introduced to computer programming concepts using microcontrollers to program computer circuits and hardware. Microcontrollers such as the Arduino and ESP32 will be used to interface with circuits constructed on prototyping boards. Course content includes both software and hardware troubleshooting.

Prerequisites/Corequisites:
Course Completion of ELEC 54B

Recommended Preparation:

Limits on Enrollment:

Schedule of Classes Information:
Description: In this course students will be introduced to computer programming concepts using microcontrollers to program computer circuits and hardware. Microcontrollers such as the Arduino and ESP32 will be used to interface with circuits constructed on prototyping boards. Course content includes both software and hardware troubleshooting. (Grade Only)
Prerequisites/Corequisites: Course Completion of ELEC 54B

Recommended:
Limits on Enrollment:
Transfer Credit: CSU;
Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

AS Degree:	**Area**	Effective:	Inactive:
CSU GE:	**Transfer Area**	Effective:	Inactive:
IGETC:	**Transfer Area**	Effective:	Inactive:

CSU Transfer:	Transferable	Effective:	Fall 2018	Inactive:
UC Transfer:		Effective:		Inactive:

CID:

Certificate/Major Applicable:
Both Certificate and Major Applicable

COURSE CONTENT

Student Learning Outcomes:
At the conclusion of this course, the student should be able to:
1. Write programs in a high-level programming language, such as the C++ derived Arduino language, to control two different microcontrollers
2. Use a microcontroller to detect inputs from sensors.
3. Control LEDs, servo motors, speakers, and other devices in response to inputs and programming.

Objectives:
At the conclusion of this course, the student should be able to:
1. Convert between number systems (binary and hexadecimal).
2. Develop truth tables for logic gates.
3. Download and run a program to a microcontroller.
4. Use editors to compose programming code and compilers to produce executable software.
5. Describe basic hardware interfaces at the conceptual level.
6. Program an Atmega328 to control a DC motor.
7. Build an Atmega328 microcontroller circuit on a prototyping board.

Topics and Scope:

I. Computers and Microcontrollers
  A. Algorithms and problem solving
  B. Setting up the microcontroller and programming environment
II. Logic Gates
III. Microcontrollers
  A. Setting up the programming environment
  B. Memory Concepts
  C. Declarations and variables

D. Assignment and initialization
IV. Digital Inputs and Outputs
V. Analog Sensors
VI. Conditional Statements
VII. Reading Digital Input Pins
VIII. Making Decisions with If, If-else
A. Comparison operators and relational expressions
B. Boolean expressions
IX. Repeating with Loops
X. Numbers and Arithmetic
A. Analog measurements
B. Numerical types
C. Numerical operators
D. Arithmetic expressions
E. Mathematical functions
XI. Functions
A. Introduction to functions
B. Defining a function to repeat an action
XII. Arrays
A. Seven-segment LED displays
B. Using lists for data
C. Reading and writing array data
XIII. Data File Basics with Serial I/O
A. Reading from files
B. Writing to files
XIV. Working with Third-Party Libraries
XV. Communications and Serial I/O
XVI. Common Hardware Interfaces
A. UART
B. I2C
C. SPI
D. Interrupt driven I/O
XVII. Common Microcontrollers
A. Arduino
B. PicAxe
C. Intel
XVIII. Constructing an Atmega328 Microcontroller
A. Reading a Schematic
B. Constructing the circuit
C. Wiring inputs and outputs

All topics are covered in the lecture and lab portions of the course.

Assignment:

Lecture-Related Assignments:
1. Textbook readings (20-30 pages per week)
2. Homework assignments (10-15)
3. Quizzes (2-6)
4. Final exam

Lab-Related Assignments:

1. Lab assignments (8-14)
2. Program documentation (8-14)

Methods of Evaluation/Basis of Grade:

Writing: Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

Program documentation	Writing 20 - 30%

Problem Solving: Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

Homework assignments; lab assignments	Problem solving 30 - 40%

Skill Demonstrations: All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

None	Skill Demonstrations 0 - 0%

Exams: All forms of formal testing, other than skill performance exams.

Quizzes; final exam	Exams 30 - 40%

Other: Includes any assessment tools that do not logically fit into the above categories.

None	Other Category 0 - 0%

Representative Textbooks and Materials:
Mechatronics: Electrical Control Systems in Mechanical and Electrical Engineering. 7th ed. Bolton, W. Pearson Higher Education, Inc. 2019.