**El Camino College**
**COURSE OUTLINE OF RECORD - Approved**

## I. GENERAL COURSE INFORMATION

**Subject and Number:** Electronics and Computer Hardware Technology 191
**Descriptive Title:** Introduction to Microprocessors and Interfacing
**Course Disciplines:** Electronics AND Electronic Technology
**Division:** Industry and Technology

**Catalog Description:**
This course is an introduction to industrial microprocessors as they relate to industrial and consumer equipment. Included are the fundamentals of computer languages, use of software to simulate hardware, digital and analog interfacing, data storage, and troubleshooting.

**Conditions of Enrollment:**
**Prerequisite:** Electronics and Computer Hardware Technology 11 or Electronics and Computer Hardware Technology 130 or Engineering Technology 14 or Manufacturing Technology 70 with a minimum grade of C.

**Course Length:** X Full Term Other (Specify number of weeks):
**Hours Lecture:** 2.00 hours per week TBA
**Hours Laboratory:** 4.00 hours per week TBA
**Course Units:** 3.00

**Grading Method:** Letter
**Credit Status:** Associate Degree Credit

**Transfer CSU:** X Effective Date: Prior to July 1992
**Transfer UC:** No

**General Education:**

**El Camino College:**

**CSU GE:**

**IGETC:**

**II. OUTCOMES AND OBJECTIVES**

**A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)**

1. SLO #1 MACHINE ASSEMBLY(Remove) High Level Programming (Replace) LANGUAGE
   Students will demonstrate their knowledge of fundamentals of machine assembly (remove) High Level Programming (replace) language.

2. SLO #2 DIGITAL AND ANALOG INTERFACING
   Students will demonstrate their use of software to simulate hardware and digital and analog interfacing.

3. SLO #3 MICROPROCESSORS AND MICROCONTROLLERS
   Students will demonstrate their knowledge of microprocessors and microcontrollers as they relate to industrial and consumer equipment.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at http://www.elcamino.edu/academics/slo/.

**B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each) assessment method for each)**

1. Recognize how both hardware and software work together in a system.
   - Laboratory reports
2. Understand the basics of troubleshooting a microprocessor system.
   - Laboratory reports
3. Understand how microprocessor data is transferred.
   - Laboratory reports
4. Understand how timing and interrupts operate.
   - Laboratory reports
5. Recognize the differences in serial and parallel interfaces and the timing requirements.
   - Laboratory reports
6. Set up an oscilloscope to measure the clock and output waveforms of a microprocessor.
   - Laboratory reports
7. Outline the steps required to solve a problem and convert the steps into a logical program.
   - Objective Exams
8. Recognize the trade off between different microprocessor architectures and why some applications may find one architecture better than another.
   - Objective Exams

**III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)**

| Lecture or Lab | Approximate Hours | Topic Number | Major Topic |
|---|---|---|---|
| Lecture | 6 | I | MICROPROCESSORS AND INTERFACING OVERVIEW<br>A. Hardware and software introduction<br>B. Digital concepts<br>C. Logic (AND, OR, XOR)<br>D. Decimal, Binary, and Hex numbers<br>E. Different microprocessor architectures |
| Lab | 12 | II | MICROPROCESSORS AND INTERFACING OVERVIEW<br>A. Hardware and software introduction<br>B. Digital concepts<br>C. Logic (AND, OR, XOR)<br>D. Decimal, Binary, and Hex numbers<br>E. Different microprocessor architectures |
| Lecture | 2 | III | MEMORY AND DATA STORAGE<br>A. Random Access Memory (RAM)<br>B. Read Only Memory (ROM)<br>C. Programmable Read Only Memory (PROM), Erasable Programmable Read Only Memory (EPROM) and Electrically Erasable Programmable Read Only Memory (EEPROM)<br>D. Volatile and non-volatile memories<br>E. Memory paging<br>F. Other forms of data storage |
| Lab | 4 | IV | MEMORY AND DATA STORAGE<br>A. RAM<br>B. ROM<br>C. PROM, EPROM and EEPROM<br>D. Volatile and non-volatile memories<br>E. Memory paging<br>F. Other forms of data storage |
| Lecture | 2 | V | BASIC INPUT/OUTPUT (I/O)<br>A. Push button<br>B. Switches<br>C. Speakers<br>D. Light Emitting Diodes (LED)s<br>E. Liquid Crystal Display (LCD)s<br>F. Sensors<br>G. Serial and parallel data |

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| Lab | 4 | VI | BASIC I/O<br>A. Push button<br>B. Switches<br>C. Speakers<br>D. LEDs<br>E. LCDs<br>F. Sensors<br>G. Serial and parallel data |
| Lecture | 4 | VII | ANALOG TO DIGITAL AND DIGITAL TO ANALOG<br>A. Analog to Digital (A/D) converters<br>B. Digital to Analog (b) converters<br>C. PWM (Pulse Width Modulation)<br>D. Use of Resistive-Capacitive (RC) time measurements |
| Lab | 8 | VIII | ANALOG TO DIGITAL AND DIGITAL TO ANALOG<br>A. A/D converters<br>B. D/A converters<br>C. PWM<br>D. Use of RC time measurements |
| Lecture | 2 | IX | TEAM PROJECT<br>A. Assignment<br>B. Requirements<br>C. Work ethic and responsibility |
| Lab | 4 | X | TEAM PROJECT<br>A. Assignment<br>B. Requirements<br>C. Work ethic and responsibility |
| Lecture | 4 | XI | TIMING AND INTERRUPTS<br>A. Clocking choices<br>B. Accuracy<br>C. Counting clock cycles in a program<br>D. Time delays<br>E. Measuring time<br>F. Non-maskable interrupts<br>G. Maskable interrupts |
| Lab | 8 | XII | TIMING AND INTERRUPTS<br>A. Clocking choices<br>B. Accuracy<br>C. Counting clock cycles in a program<br>D. Time delays<br>E. Measuring time<br>F. Non-maskable interrupts<br>G. Maskable interrupts |

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|---|---|---|---|
| Lecture | 4 | XIII | PSEUDO CODE AND OTHER PROBLEM SOLVING TECHNIQUES<br>A. Pseudo code<br>B. Flow charts<br>C. Stub code<br>D. Subroutines<br>E. Troubleshooting hardware and software problems |
| Lab | 8 | XIV | PSEUDO CODE AND OTHER PROBLEM SOLVING TECHNIQUES<br>A. Pseudo code<br>B. Flow charts<br>C. Stub code<br>D. Subroutines<br>E. Troubleshooting hardware and software problems |
| Lecture | 8 | XV | MICROPROCESSOR INSTRUCTIONS AND REGISTERS<br>A. Instructions and data flow<br>B. Register architecture<br>C. Addressing modes<br>D. Development tools |
| Lab | 16 | XVI | MICROPROCESSOR INSTRUCTIONS AND REGISTERS<br>A. Instructions and data flow<br>B. Register architecture<br>C. Addressing modes<br>D. Development tools |
| Lecture | 4 | XVII | MOTOR CONTROL AND ELECTROMAGNETIC ACTUATORS<br>A. Stepper motors<br>B. Servos<br>C. Solenoids<br>D. Feedback |
| Lab | 8 | XVIII | MOTOR CONTROL AND ELECTROMAGNETIC ACTUATORS<br>A. Stepper motors<br>B. Servos<br>C. Solenoids<br>D. Feedback |
| Total Lecture Hours | | 36 | |
| Total Laboratory Hours | | 72 | |
| Total Hours | | 108 | |

## IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

### A. PRIMARY METHOD OF EVALUATION:

Problem solving demonstrations (computational or non-computational)

### B. TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:

Construct a circuit and write the code to read a set of input switches, and transfer this input to LED outputs. Upon completion, consult instructor for evaluation.

### C. COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:

1. Construct a circuit and develop the code that will drive a seven-segment display. One push button will increment the count and the other push button will decrement the count on the display. Build and demonstrate the operation of the circuit to the instructor.

2. Build a stepper motor circuit and develop the code to turn the motor both clockwise and counterclockwise using single and dual phase operation. Upon completion, demonstrate the operation of the circuit to the instructor.

### D. OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:

Other exams
Quizzes
Laboratory reports
Class Performance
Homework Problems
Multiple Choice
Completion
True/False

## V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Group Activities
Laboratory
Lecture
Multimedia presentations

**Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.**

## VI. WORK OUTSIDE OF CLASS

Study
Answer questions
Required reading
Problem solving activities

**Estimated Independent Study Hours per Week:** 4

## VII. TEXTS AND MATERIALS

### A. UP-TO-DATE REPRESENTATIVE TEXTBOOKS

Jeremy Blum. Exploring Arduino. John Wiley, 2019.

### B. ALTERNATIVE TEXTBOOKS

### C. REQUIRED SUPPLEMENTARY READINGS

### D. OTHER REQUIRED MATERIALS

## VIII. CONDITIONS OF ENROLLMENT

### A. Requisites (Course and Non-Course Prerequisites and Corequisites)

| Requisites | Category and Justification |
|---|---|
| Course Prerequisite<br>Electronics and Computer Hardware Technology-11 or | Other Knowledge and Skills |
| Course Prerequisite<br>Electronics and Computer Hardware Technology-130 or | Other Knowledge and Skills |
| Course Prerequisite<br>Engineering Technology-14 or | Other Knowledge and Skills |
| Course Prerequisite<br>Manufacturing Technology-70 | Other Knowledge and Skills |

### B. Requisite Skills

| Requisite Skills |
|---|
| **Read and understand schematic symbols.**<br>ECHT 11 -Differentiate color codes and component symbols to build a circuit.<br><br>MTEC 70 - Examine and identify the electronic and mechanical components of a robot. Familiarize with the necessary tools to build the prototype robot.<br><br>ECHT 130 - Design, construct, and test a small digital system, which may include one or more of the following functions: encoders and decoders, multiplexers and demultiplexers, parity generators and decoders, and MOD n counters.<br><br>ETEC 14 - Recognize electronic schematic symbols and determine use.<br><br>**Ability to build basic circuits using a prototyping board.**<br>ECHT 11 -Differentiate color codes and component symbols to build a circuit.<br><br>ETEC 14 - Describe the sequences in building and analyzing a simple circuit. |

MTEC 70 -Construct electronic circuits using a breadboard or protoboard. Configure circuits using electronic devices typical to robots (e.g., resistors, Light Emitting Diode (LED), integrated circuit, piezospeaker).

ECHT 130 -Design, construct, and test a small digital system, which may include one or more of the following functions: encoders and decoders, multiplexers and demultiplexers, parity generators and decoders, and MOD n counters.

**Knowledge of basic electronic components like resistors, LEDs, capacitors, and speakers.**
ECHT 11 - Differentiate color codes and component symbols to build a circuit.

ETEC 14 - Describe the sequences in building and analyzing a simple circuit.

MTEC 70 - Examine and identify the electronic and mechanical components of a robot. Familiarize with the necessary tools to build the prototype robot."

MTEC 70 - Construct electronic circuits using a breadboard or protoboard. Configure circuits using electronic devices typical to robots (e.g., resistors, Light Emitting Diode (LED), integrated circuit, piezospeaker).

ECHT 130 - Design, construct, and test a small digital system, which may include one or more of the following functions: encoders and decoders, multiplexers and demultiplexers, parity generators and decoders, and MOD n counters.

**Ability to use and connect basic electronic equipment such as a power supply, a digital multimeter, and an oscilloscope.**
MTEC 70 - Examine and identify the electronic and mechanical components of a robot. Familiarize with the necessary tools to build the prototype robot.

ETEC 14 -Connect meters to a circuit and obtain accurate measurements.

ECHT 130 - Design, construct, and test a small digital system, which may include one or more of the following functions: encoders and decoders, multiplexers and demultiplexers, parity generators and decoders, and MOD n counters.

ECHT 11 - Demonstrate the use of various types of test equipment, including Digital Multimeter (DMM), signal generators, power supplies and oscilloscope to make various circuit measurements.

**C. Recommended Preparations (Course and Non-Course)**

| Recommended Preparation | Category and Justification |
|---|---|

**D. Recommended Skills**

| Recommended Skills |
|---|

**E. Enrollment Limitations**

| Enrollment Limitations and Category | Enrollment Limitations Impact |
|---|---|

**Course created by Walter Kahan on 02/01/1988.**

**BOARD APPROVAL DATE:**

**LAST BOARD APPROVAL DATE: 05/21/2019**

**Last Reviewed and/or Revised by: BOB DIAZ** **Date: October 23, 2018**

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