CIC Approval: 10/12/2006
BOT APPROVAL: 11/14/2006
STATE APPROVAL:
EFFECTIVE TERM: Spring 2007

SAN DIEGO COMMUNITY COLLEGE DISTRICT
MIRAMAR COLLEGE
ASSOCIATE DEGREE COURSE OUTLINE

SECTION I

SUBJECT AREA AND COURSE NUMBER: Computer and Information Sciences 071

COURSE TITLE: Intro to Embedded Computer Programming and Design **Units:** 4
Grade Only

CATALOG COURSE DESCRIPTION:

This course introduces students to programming and interfacing microcontrollers to the world around them. Topics include programming a microcontroller to respond to inputs and to control various devices, such as LEDs, fans, servos, and relays.

REQUISITES:

Advisory:
ENGL 049 with a grade of "C" or better, or equivalent or Assessment Skill Level W5
and
ENGL 048 with a grade of "C" or better, or equivalent or Assessment Skill Level R5

FIELD TRIP REQUIREMENTS: May be required

TRANSFER APPLICABILITY: Associate Degree Credit only and not Transferable

TOTAL LECTURE HOURS: 48 - 54

TOTAL LAB HOURS: 48 - 54

STUDENT LEARNING OBJECTIVES:
Upon successful completion of the course the student will be able to:

1. Show the proper connection of the microcontroller to the interface computer.
2. Describe the use of an LED to indicate the state of a microcontroller output.
3. Experiment with a pushbutton to change the state of a microcontroller.
4. Examine a microcontroller circuit to control a servo using low voltage pulses.
5. Apply the use of a microcontroller to measure rotation of an object.
6. Change a microcontroller circuit to control both a digital display and an LED.
7. Modify a circuit to measure light using a various sensors.
8. Summarize the use of a microcontroller to produce and detect sound.
9. Experiment with a microcontroller in conjunction with an integrated circuit.
10. Explain the use of a microcontroller in the integration of various inputs and outputs.
11. Compare various techniques to record events for later retreival.
12. Design a circuit using a microcontroller to monitor the charging of a battery.
13. Connect a microcontroller in an integrated experiment to track an energy source such as light or sound.
14. Descriminate the use of a microcontroller to microprocessors in the development of embedded applications.
15. Demonstrate how to use a microcontroller to communicate with an EEPROM using the I2C protocol.

SECTION II

1. COURSE OUTLINE AND SCOPE:

A. **Outline Of Topics:**
The following topics are included in the framework of the course but are not intended as limits on content. The order of presentation and relative emphasis will vary with each instructor.

I. Overview
   A. Microcontrollers
   B. Installing the software.

II. Simple outputs
   A. Controlling an LED
   B. Counting and repeating
   C. Bi-color LEDs.

III. Digital inputs
   A. Pushbuttons
   B. Detecting high/low signals
   C. Reaction timing.

IV. Controlling motion
   A. Servos
   B. Position a servo with software
   C. Pushbutton controlled servo.

V. Measuring rotation
   A. Potentiometers
   B. Resistance and time
   C. Reading resistance with software
   D. Controlling a servo with a potentiometer.

VI. Digital display
   A. 7-segment displays
   B. Controlling a 7-segment display
   C. Displaying the position of a potentiometer.

VII. Measuring light
   A. Photoresistors
   B. Light meters
   C. Graphing light measurements
   D. Tracking light events.

VIII. Frequency and sound
   A. Speakers, Piezo elements
   B. Action sounds
   C. Musical notes
   D. Microcontroller music
   E. Cell phone ring tones.

IX. Electronic building blocks
   A. Transistors and integraged circuits
   B. Controlling a transistor with software
   C. Digital potentiometers.

X. System integration
   A. Modular programming
   B. Testing subsystems.

XI. Renewable energy
   A. Using graphing software
   B. A/D and D/A conversion.

XII. Battery chargers
   A. How rechargable batteries work
   B. Reading battery voltage with software
   C. Programmable battery charger.

XIII. Solor cells
   A. How solar cells work

B. Dueling solar cells.

XIV. Sun tracker
   A. Solar arrays
   B. Connecting solar cells to a servo-tracking mechanism.

XV. Half wave and full wave rectification
   A. Principles of half wave rectification
   B. Programming a half wave rectifier.

XVI. Three phase AC alternator
   A. Understanding three-phase power
   B. Programming the three-phase AC alternator.

B. **Reading Assignments:**
Reading assignments are required and may include but, are not limited to, the following:

I. Periodicals, such as Circuit Cellar, Nuts and Volts, Sensor, Silicon Chip, Smart Computing, and PC Magazine
II. Equipment documentation
III. Integrated Circuit datasheets
IV. Software documentation.

C. **Appropriate Assignments that Demonstrate Critical Thinking:**
Critical thinking assignments are required and may include, but are not limited to, the following:

I. Assessing the use of a microcontroller in conjunction with an integrated circuit
II. Evaluating the connection of a microcontroller to plotting software to record events
III. Proposing the use of a pushbutton to change the state of a microcontroller
IV. Arranging the use of a microcontroller to communicate with an EEPROM using the I2C protocol.

D. **Appropriate Outside Assignments:**
Outside assignments may include, but are not limited to, the following:

I. Interfacing a microcontroller to a weather vane
II. Connecting two microcontrollers together and sending messages back and forth between them
III. Connecting a solar cell to a microcontroller and charging a battery.

E. **Writing Assignments:**
Writing assignments are required and may include, but are not limited to, the following:

I. Developing computer programs to control input and output from a microcontroller
II. Preparing documentation for projects
III. Preparing reports on the results of microcontroller experiments.

2. METHODS OF EVALUATION:

A student's grade will be based on multiple measures of performance unless the course requires no grade. Multiple measures may include, but are not limited to, the following:

I. Performance of hands-on assignments
II. Written responses to class assignments
III. Responses to class objective and/or essay question quizzes and/or examinations
IV. Development of programs in a microcontroller programming language
V. Interactive one-on-one demonstration of program testing and operation in a microcontroller programming language
VI. Participation in class discussion
VII. Development of program documentation.

3. METHODS OF INSTRUCTION:

Methods of instruction may include, but are not limited to, the following:

* Lecture
* Laboratory
* Lecture-Lab Combination
* Distance Education
* Computer Assisted Instruction
* Discussion Seminar
* Learning Modules
* Audio-Visual
* Other (Specify)
* Web-Based Tutorials

4. REQUIRED TEXTS AND SUPPLIES:
Textbooks may include, but are not limited to:

TEXTBOOKS:
1. Daubach, Gunther. Programming the SX Microcontroller, 1 ed. Parallax, 2004, ISBN: 192898228X
2. Lindsay, Andy. What's a Microconrtoller, 2.1 ed. Parallax, 2003, ISBN: 1928982026
3. Parallax Corporation. Experiments with Renewal Energy, 1 ed. Parallax, 2004, ISBN: 1928982220

MANUALS:

PERIODICALS:

SOFTWARE:

SUPPLIES:
1. What's a Microcontroller Kit, $80, Radio Shack Stock# 276-625 (includes text)
2. Experiments with Renewal Energy Parts Kit, $180, Parallax Stock# 28145 (includes text)

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CO-CONTRIBUTOR(S)
PROPOSAL DATE: 03/22/2005