GENERAL:
Course Id: CET335
Course Name: Microprocessor Interfacing
Credits: 4
Prerequisites: CET270 – Introduction to Microprocessor Design
CET235 – Digital Electronics Design
Revision Date: August, 2010

COURSE DESCRIPTION:
This course deals with advanced concepts in the programming and the interfacing of microprocessors/microcontrollers to the outside world as demonstrated by a variety of application examples. It covers the advanced architecture of modern processors and the many I/O peripherals now commonly found on-board the device. Detailed studies of computer I/O and interrupt techniques as applied to analog-to-digital, digital-to-analog, timers, parallel and serial interfaces are included. Laboratory activities provide the student with experience in developing the hardware and software required to incorporate microprocessors into systems that solve real-world interfacing problems.

COURSE OBJECTIVES:
On successful completion of the course, the student should be able to:
A. describe advanced microprocessor architecture and programming,
B. describe the difference between a microprocessor and a microcontroller,
C. design, develop, and validate microprocessor-based system software,
D. demonstrate increased proficiency in software programming,
E. develop and analyze schematics / logic diagrams for microprocessor-based systems,
F. determine and optimize a design for an input/output (I/O) device,
G. explain the operation and application of computer interrupts,
H. design and validate a parallel I/O interface,
I. choose an analog-to-digital converter (ADC) based on relevant specifications,
J. choose a digital-to-analog converter (DAC) based on relevant specifications,
K. design real-world interfaces incorporating ADCs and DACs
L. describe the operation and application of serial communication interfaces,
M. describe the operation and application of serial peripheral interfaces and devices,
N. describe the operation and application of computer timer devices,
O. design for and interface to I/O devices incorporating ADCs, DACs, timer and serial methods,
P. synthesize and develop microprocessor interfaces for various I/O devices in general,
R. work in teams,
S. produce written documents and to give oral presentations, and
T. construct circuits, use test equipment and use technical problem solving skills.

COURSE OUTLINE:
A. Introduction
   1. orientation
   2. course overview
B. Overview/review of Microcontroller Architecture
   1. register set design and usage
   2. addressing modes and applications
   3. instruction set and timing
   4. memory and peripheral mapping
   5. hardware implementation and I/O support
   6. analysis of application examples
      a. recursion and stack usage
      b. traffic light controller
C. Input / Output Architecture
1. Logic families & specifications
2. Binary input ports
3. Schmitt triggered inputs
4. Binary output ports
5. Tri-state logic
6. Bidirectional ports
7. Software I/O control techniques
   a. Polling / programmed
   b. Interrupt-driven
   c. Direct memory access
   d. Multiplexed I/O

D. Digital Interfacing
1. Binary input devices
   a. Mechanical switch inputs
   b. Contact debouncing
   c. Mechanical switch devices (thermostats, thermal fuses, mercury switches, magnetic reed)
   d. Solid-state switch devices (optical, magnetic)
   e. Pseudo-binary inputs
   f. Keypads
2. Binary output devices
   a. LEDs
   b. Relays / solenoids
   c. Analog switches
3. Parallel I/O
   a. I/O synchronization
   b. Time multiplexed LED display
   c. Parallel printer interface standard
   d. LCD modules
4. Digital I/O expansion

E. Analog Interfacing
1. Digital to analog converters
   a. DAC operation
   b. DAC specifications
   c. DAC types
   d. DAC interfacing
   e. DAC applications
2. Analog to digital converters
   a. ADC operation
   b. ADC specifications
   c. ADC types
   d. ADC interfacing
3. Sensors
   a. Temperature
   b. Pressure
   c. Motion / accelerometers
   d. Sound
   e. Chemical

F. Time-based I/O
1. Hardware timers and real-time interrupts
2. Output compare operations
3. Input capture operations
4. Applications and implementation
   a. Time keeping / software scheduling
   b. Pulse accumulation
   c. Voltage controlled oscillators (VCO)
   d. Pulse-width modulation (PWM)
   e. DC motor control
f. stepper motor control

G. Data Communications
   1. legacy serial I/O
      a. serial interface components
      b. serial data transmission
      c. serial communication standards
      d. serial interface implementation
   2. special purpose devices
      a. magnetic stripe readers
   3. protocol-based serial I/O
      a. CAN
      b. SPI
      c. IIC
      d. USB
      e. Zigbee

SUPPORTIVE MATERIALS:


STUDENTS WITH DISABILITIES

Students reserve the right to decide when to self-identify and when to request accommodations. Students requesting approval for reasonable accommodations should contact the Office for Students with Disabilities (OSD). Students are expected to adhere to OSD procedures for self-identifying, providing documentation and requesting accommodations in a timely manner. Students will present the OSD Accommodation Approval Notice to faculty when requesting accommodations that involve the faculty.

Contact Information:

- Location: Carter Hall - G-35
- Phone: (724) 938-5781
- Fax: (724) 938-4599
- Email: osdmail@calu.edu
- Web Site: www.calu.edu/osd
California University of Pennsylvania and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with the Title IX of the Education Amendments of 1972 and guidance from the Office of Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator, Dr. John A. Burnett, Special Assistant to the President for EEO, Office of Social Equity, South Hall 112, Burnett@calu.edu, 724-938-4014. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (person under 18 years of age) when the abuse allegedly occurred to the person designated in the University protection of minors policy.

The University’s information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at:

- **Office of Social Equity**, South Hall 112, 724-938-4014
  - Social Equity Home Page [www.calu.edu/SocialEquity](http://www.calu.edu/SocialEquity)
  - Social Equity Policies [www.calu.edu/SEpolicies](http://www.calu.edu/SEpolicies)
  - Social Equity Compliant Form [www.calu.edu/SEcomplaint](http://www.calu.edu/SEcomplaint)
- **Counseling Center**, Carter Hall G53, 724-938-4056
- **End Violence Center**, Carter Hall G94, 724-938-5707
- **Student Affairs**, Natali Student Center 311, 724-938-4439
- **Wellness Center**, Carter Hall G53, 724-938-4232
- **Women's Center**, Natali Student Center 117, 724-938-5857
- **Threat Response Assessment and Intervention Team (T.R.A.I.T.) & Dept. of Public Safety & University Police**, Pollock Maintenance Building, 724-938-4299
  - **EMERGENCY**: From any on-campus phone & Dial H-E-L-P or go to any public pay phone & Dial *1. (*Identify the situation as an emergency and an officer will be dispatched immediately.*)