

California University of Pennsylvania Guidelines for New
Course Proposals
University Course Syllabus
Department of Computing and Engineering Technology UCC
Approval date: 3/18/2019

A. Protocol

Course Name: MICROPROCESSOR INTERFACING
Course Number: ECET3535
Credits: 4
Prerequisites: ECET2570 Intro to Microprocessor Design
Maximum Class Size (face-to-face): 24 per lab section
Maximum Class Size (online): N/A
Revision Date: Spring 2023

B. Objectives of the Course:

Upon successful completion of this course, the student should be able to:

1. Describe requirements of microprocessor interfaces to the real-world.
2. Describe microprocessor input/output architectures for digital interfaces.
3. Interface and program various digital input/output devices to the microprocessor.
4. Describe the operation of analog-to-digital (A/D) and digital-to-analog (D/A) converters.
5. Apply and program A/D and D/A converter devices.
6. Describe and implement various sensor and actuator devices in real-world scenarios.
7. Describe the operation and application of hardware timer devices.
8. Describe the operation of serial interfacing with communication links and peripheral devices.
9. Demonstrate increased proficiency in software programming.
10. Construct microprocessor interfacing circuits, use test equipment and apply technical problem solving skills.

C. Catalog 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. Three lecture-hours and three laboratory-hours per week.

D. Outline of the Course:

1. Introduction
 - a. orientation
 - b. course overview
2. Overview/review of Microcontroller Architecture
 - a. register set design and usage
 - b. addressing modes and applications
 - c. instruction set and timing
 - d. memory and peripheral mapping
 - e. hardware implementation and I/O support
 - f. analysis of application examples
 - i. recursion and stack usage
 - ii. traffic light controller
3. Input / Output Architecture
 - a. logic families & specifications
 - b. binary input ports
 - c. Schmitt triggered inputs
 - d. binary output ports
 - e. tri-state logic
 - f. bidirectional ports
 - g. software I/O control techniques
 - i. polling / programmed
 - ii. interrupt-driven

- iii. direct memory access
 - iv. multiplexed I/O
- 4. Digital Interfacing
 - a. binary input devices
 - i. mechanical switch inputs
 - ii. contact debouncing
 - iii. mechanical switch devices (thermostats, thermal fuses, mercury switches, magnetic reed)
 - iv. solid-state switch devices (optical, magnetic)
 - v. pseudo-binary inputs
 - vi. keypads
 - b. binary output devices
 - i. LEDs
 - ii. relays / solenoids
 - iii. analog switches
 - c. parallel I/O
 - i. I/O synchronization
 - ii. time multiplexed LED display
 - iii. parallel printer interface standard
 - iv. LCD modules
 - d. digital I/O expansion
- 5. Analog Interfacing
 - a. digital to analog converters
 - i. DAC operation
 - ii. DAC specifications
 - iii. DAC types
 - iv. DAC interfacing
 - v. DAC applications
 - b. analog to digital converters
 - i. ADC operation
 - ii. ADC specifications
 - iii. ADC types
 - iv. ADC interfacing
 - c. sensors
 - i. temperature
 - ii. pressure
 - iii. motion / accelerometers
 - iv. sound
 - v. chemical
- 6. Time-based I/O
 - a. hardware timers and real-time interrupts
 - b. output compare operations
 - c. input capture operations
 - d. applications and implementation
 - i. time keeping / software scheduling
 - ii. pulse accumulation
 - iii. voltage controlled oscillators (VCO)
 - iv. pulse-width modulation (PWM)
 - v. DC motor control
 - vi. stepper motor control
- 7. Data Communications
 - a. legacy serial I/O
 - i. serial interface components
 - ii. serial data transmission
 - iii. serial communication standards
 - iv. serial interface implementation
 - b. special purpose devices
 - i. magnetic stripe readers
 - c. protocol-based serial I/O
 - i. CAN
 - ii. SPI
 - iii. IIC
 - iv. USB

v. Zigbee

E. Teaching Methodology:

- 1) Traditional Classroom Methodology
Instruction will occur using, but not limited to, lecture, demonstrational, and laboratory methods. Three hours lecture plus three hours lab per week.
- 2) Online Methodology
N/A.

F. Text:

Jonathan W Valvano (2014). Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers, Fifth Edition (Volume 1)

G. Assessment Activities:

- 1) Traditional Classroom Assessment
Students will be assessed using assignments, exams, quizzes, laboratory exercises, computer projects, course major project, attendance and/or performance according to a grading scale developed by the instructor.
- 2) Online Assessment
N/A

H. Accommodations for Students with Disabilities:

OSD

Revised June 2015

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: <http://www.calu.edu/osd>

I. Title IX Syllabus Addendum

Revised January 2018

**California University of Pennsylvania
Reporting Obligations of Faculty Members under Title IX
of the Education Amendments of 1972, 20 U.S.C. §1681, et seq.**

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

- Social Equity Policies www.calu.edu/SEpolicies
- Social Equity Complaint Form www.calu.edu/SEcomplaint
- **Counseling Center**, Carter Hall G53, 724-938-4056
- **End Violence Center**, Natali Student Center 117, 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.)

J. Supportive Instructional Materials, e.g. library materials, web sites, etc.

- Cady, *Microcontrollers and Microcomputers*, 1997.
- Cady, *Software and Hardware Engineering: Motorola M68HC11*, 1997.
- 001.644 C311i Carr, Joseph J., *Interfacing your microcomputer to virtually anything*, 1984.
- 001.644 C649i Cluley, J.C., *Interfacing to Microprocessors*, 1983.
- 004.6 D431i Derenzo, Stephen E., *Interfacing*, 1990.
- Freescale Semiconductor Inc., *MC9S12DT256 Device User Guide*, 2006.
- 621.381952 G674C Gorsline, G.W., *Computer Organization: Hardware/Software*, 1980.
- Greenfield, J.D., *The 68HC11 Microcontroller*, 1991.
- Huang, *MC68HC11 An Introduction Software and Hardware Interfacing*, 1996.
- Huang, *The HCS12/9S12: An Introduction to Software and Hardware Interfacing, 2nd ed.*, Delmar, 2010.
- 621.39 K64 Kleitz, William, *Digital and Microprocessor Fundamentals*, 1990.
- 004.6 L764s Lipovski, G.J., *Single- and Multiple-Chip Microcomputer Interfacing*, 1988.
- M68HC11 Reference Manual*, Motorola, 1991.
- 621.3981 P363d Peatman, John, *Design with Microcontrollers*, 1988.
- 004.62 P988r Putman, Byron, *RS-232 Simplified: Everything you need to know*, 1987.
- Spasov, P., *Microcontroller Technology, The 68HC11, 2nd ed.*, 1996.
- 621.381959 Z21 Zaks, Rodney, *Microprocessor Interfacing Techniques*, 1979.
- Zaks, Rodney, *From Chips to Systems*, 1981.
- www.m-w.com, Merriam-Webster's OnLine Collegiate Dictionary & Thesaurus.

Additional Information for Course Proposals

K. Proposed Instructors:

Any CET faculty member.

L. Rationale for the Course:

This course, a major requirement for the revised Electrical Engineering Technology and new Computer Engineering Technology programs, is needed as a replacement for a previous course to bring the microprocessor area of the EET program into compliance with ABET requirements. Specified class size is limited by available laboratory equipment.

M. Specialized Equipment or Supplies Needed:

Existing resources and equipment already available in the engineering technology laboratories will be used.

N. Answer the following questions using complete sentences:

1. Does the course require additional human resources? (Please explain)
No.

2. Does the course require additional physical resources? (Please explain)
No.
 3. Does the course change the requirements in any particular major? (Please explain)
No.
 4. Does the course replace an existing course in your program? (If so, list the course)
No.
 5. How often will the course be taught?
Every fall semester or as needed.
 6. Does the course duplicate an existing course in another Department or College? (If the possibility exists, indicate course discipline, number, and name)
No.
- O. If the proposed course includes substantial material that is traditionally taught in another discipline, you must request a statement of support from the department chair that houses that discipline.
N/A.
- P. Please identify if you are proposing to have this course considered as a menu course for General Education. If yes, justify and demonstrate the reasons based on the categories for General Education. The General Education Committee must consider and approve the course proposal before consideration by the UCC.
No.
- Q. Approval Form (electronically).