ITT Technical Institute

ET2640

Microprocessors and Microcontrollers

Onsite and Online Course

SYLLABUS

Credit hours: 4.5

Contact/Instructional hours: 56 (34 Theory Hours, 22 Lab Hours)

Prerequisite(s) and/or Corequisite(s):

Prerequisites: ET1220 Digital Fundamentals or equivalent, ET1410 Integrated Circuits or equivalent, ET2560 Introduction to C Programming or equivalent

Course Description:

This course examines the creation, assembly, features, function, programming and product applications of contemporary microprocessors and microcontrollers. Students perform exercises in planning, designing, implementing and debugging functional microcontrollers.

COURSE SUMMARY

COURSE DESCRIPTION

This course examines the creation, assembly, features, function, programming and product applications of contemporary microprocessors and microcontrollers. Students perform exercises in planning, designing, implementing and debugging functional microcontrollers.

MAJOR INSTRUCTIONAL AREAS

1. Microcontroller/microprocessor technology and application examples
2. Microcontroller/microprocessor core functional architectures
3. Assembly language command structure concepts
4. Real-world I/O applications and interfacing considerations
5. Microcontroller peripheral function usage (A/D, D/A, timers, watchdog, and EEPROM)
6. Microcontroller programming methods and algorithms
7. Practical considerations for embedded systems applications
8. Using development tools to simulate, program, and debug applications
9. The benefits of using higher level languages, such as C

COURSE LEARNING OBJECTIVES

By the end of this course, you should be able to:

1. Use numerical methods for processor-based systems to perform calculations and conversions related to programming.
2. Describe contemporary wide-ranging microprocessor and microcontroller product applications.
3. Use development tools to simulate, debug, assemble and download code into a microcontroller.
4. Describe the function of the program counter, data registers, and accumulators.
5. Explain the function of the 8051 SBUF, SCON, PCON, TMOD, and TCON registers.
6. Write assembly programs to perform arithmetic operations, bit-wise logical operations, compare operations, and shift operations.

7. Program the 8051 using the C programming language to access look-up table values by indirect addressing, to access some or all of the 8 bits of a port, and to use the stack pointer to access a stack data storage area.
8. Program the 8051 using the C programming language to transmit and receive data from the serial port, generate a time delay, and perform I/O operations, timer operations with interrupts, external hardware interrupts, and serial communications with interrupts.
9. Control LED (light emitting diode), sound, ADC (analog to digital), and RTC (real-time clock) devices with the 8051 using the C programming language.
10. Explain how to interface sensors with the 8051.

COURSE OUTLINE

MODULE 1: INTRODUCTION TO MICROPROCESSORS AND MICROCONTROLLERS

COURSE LEARNING OBJECTIVES COVERED

- Use numerical methods for processor-based systems to perform calculations and conversions related to programming.
- Describe contemporary wide-ranging microprocessor and microcontroller product applications.
- Use development tools to simulate, debug, assemble and download code into a microcontroller.

TOPICS COVERED

- Microcontroller/Microprocessor Introduction
- Binary System Mathematics and Conversions
- Semiconductor Memory Capacity and Organization
- Bus Design and Address Decoding
- CPU Architecture
- Overview of the 8051 Microcontroller
- 8051 Assembler and Simulator

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Mazidi, Mazidi, & McKinlay, Chapter 0 and Chapter 1.	No	6 hr
Lesson: Study the lesson for this module.	No	1.5 hr
Exercise: Submit the exercise titled “Basic Concepts and Numerical Methods.”	Yes	1 hr
Lab: Complete the lab titled “Assembling Programs and Using the Simulator.”	Yes	N/A
Project: Read and begin the project.	No	1 hr

Total Out-Of-Class Activities: 9.5 Hours

MODULE 2: 8051 ASSEMBLY LANGUAGE PROGRAMMING

COURSE LEARNING OBJECTIVES COVERED

- Describe the function of the program counter, data registers, and accumulators.
- Explain the function of the 8051 SBUF, SCON, PCON, TMOD, and TCON registers.
- Write assembly programs to perform arithmetic operations, bit-wise logical operations, compare operations, and shift operations.

TOPICS COVERED

- 8051 Assembly Language Programming
- Program ROM and Data RAM
- Major Registers
- PSW Register
- Register Banks and Stacks
- LOOP, JUMP, and CALL Instructions
- Time Delay Generation
- PORT Programming

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Mazidi, Mazidi, & McKinlay, Chapters 2–5.	No	11 hr
Lesson: Study the lesson for this module.	No	2.5 hr
Discussion: Participate in the discussion titled “Assembly Language Instructions.”	Yes	1 hr
Exercise: Submit the exercise titled “8051 Programming Basics.”	Yes	1.5 hr
Lab 1: Complete the lab titled “8051 Registers, Stack, Ports, and Trainer.”	Yes	N/A
Lab 2: Complete the lab titled “I/O Operations.”	Yes	N/A
Project: Continue work on Project Part 1.	No	3 hr

Total Out-Of-Class Activities: 19 Hours

MODULE 3: 8051 C PROGRAMMING

COURSE LEARNING OBJECTIVES COVERED

- Program the 8051 using the C programming language to access look-up table values by indirect addressing, to access some or all of the 8 bits of a port, and to use the stack pointer to access a stack data storage area.
- Program the 8051 using the C programming language to transmit and receive data from the serial port, generate a time delay, and perform I/O operations, timer operations with interrupts, external hardware interrupts, and serial communications with interrupts.
- Control LED (light emitting diode), sound, ADC (analog to digital), and RTC (real-time clock) devices with the 8051 using the C programming language.

TOPICS COVERED

- Arithmetic Instructions
- Logic and Compare Instructions
- Data Types and Time Delay
- I/O Programming in 8051 C
- Logic Operations in 8051 C
- Pin Description of the 8051

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Mazidi, Mazidi, & McKinlay, Chapters 6–8.	No	11 hr
Lesson: Study the lesson for this module.	No	2.5 hr
Exercise: Submit the exercise titled “8051 Assembly Language Arithmetic and Logic Instructions.”	Yes	1.5 hr
Lab 1: Complete the lab titled “Data Manipulation and Arithmetic Operations.”	Yes	N/A
Lab 2: Complete the lab titled “Testing 8051 I/O Ports Using C.”	Yes	N/A
Project: Submit Project Part 1.	Yes	3 hr

Total Out-Of-Class Activities: 18 Hours

MODULE 4: INTERRUPT AND POLLING PROGRAMMING METHODS

COURSE LEARNING OBJECTIVES COVERED

- Program the 8051 using the C programming language to access look-up table values by indirect addressing, to access some or all of the 8 bits of a port, and to use the stack pointer to access a stack data storage area.
- Program the 8051 using the C programming language to transmit and receive data from the serial port, generate a time delay, and perform I/O operations, timer operations with interrupts, external hardware interrupts, and serial communications with interrupts.

TOPICS COVERED

- Programming 8051 Timers
- Basics of Serial Communication
- 8051 Serial Port Programming
- 8051 Interrupts
- Programming the External Hardware and Serial Communication Interrupt
- Interrupt Programming in C

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Mazidi, Mazidi, & McKinlay, Chapters 9–11.	No	12 hr
Lesson: Study the lesson for this module.	No	2.5 hr
Discussion: Participate in the discussion titled “Interrupts Programming.”	Yes	1 hr
Exercise: Submit the exercise titled “8051 Serial Communication Programming Using C.”	Yes	1.5 hr
Lab 1: Complete the lab titled “8051 Serial Port Programming.”	Yes	N/A
Lab 2: Complete the lab titled “8051 Interrupt Programming and Counters.”	Yes	N/A
Project: Begin work on Project Part 2.	No	3 hr

Total Out-Of-Class Activities: 20 Hours

MODULE 5: LCD AND KEYBOARD INTERFACING

COURSE LEARNING OBJECTIVES COVERED

- Control LED (light emitting diode), sound, ADC (analog to digital), and RTC (real-time clock) devices with the 8051 using the C programming language.
- Explain how to interface sensors with the 8051.

TOPICS COVERED

- LCD and Keyboard Interfacing
- DAC Interfacing
- Sensor Interfacing and Signal Conditioning
- 8051 Interfacing to External Memory
- Stepper Motor Interfacing

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Mazidi, Mazidi, & McKinlay, Chapters 12–15.	No	11 hr
Lesson: Study the lesson for this module.	No	2.5 hr
Exercise: Submit the exercise titled “8051 LCD and Keypad Interfacing.”	Yes	1.5 hr
Lab: Complete the lab titled “Interfacing and Programming LCDs with the 8051.”	Yes	N/A
Project: Submit Project Part 2.	Yes	3 hr
Final Exam: Prepare for the final exam.	No	5 hr

Total Out-Of-Class Activities: 23 Hours

MODULE 6: INTERFACING AND PROGRAMMING

COURSE LEARNING OBJECTIVES COVERED

- Use numerical methods for processor-based systems to perform calculations and conversions related to programming.
- Describe contemporary wide-ranging microprocessor and microcontroller product applications.
- Use development tools to simulate, debug, assemble and download code into a microcontroller.
- Describe the function of the program counter, data registers, and accumulators.
- Explain the function of the 8051 SBUF, SCON, PCON, TMOD, and TCON registers.
- Write assembly programs to perform arithmetic operations, bit-wise logical operations, compare operations, and shift operations.
- Program the 8051 using the C programming language to access look-up table values by indirect addressing, to access some or all of the 8 bits of a port, and to use the stack pointer to access a stack data storage area.
- Program the 8051 using the C programming language to transmit and receive data from the serial port, generate a time delay, and perform I/O operations, timer operations with interrupts, external hardware interrupts, and serial communications with interrupts.
- Control LED (light emitting diode), sound, ADC (analog to digital), and RTC (real-time clock) devices with the 8051 using the C programming language.
- Explain how to interface sensors with the 8051.

TOPICS COVERED

- DS12887 RTC Programming in C
- DC Motor Interfacing and PWM
- SPI and I2C Bus Protocol

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Reading: Mazidi, Mazidi, & McKinlay, Chapters 16–18.	No	5 hr
Lesson: Study the lesson for this module.	No	2.5 hr
Exercise: Submit the exercise titled “DC Motor Control and PWM.”	Yes	1.5 hr

MODULE LEARNING ACTIVITIES	GRADED	OUT-OF-CLASS TIME
Lab: Complete the lab titled “Stepper Motor.”	Yes	N/A
Final Exam: Take the final exam.	Yes	N/A

Total Out-Of-Class Activities: 9 Hours

EVALUATION AND GRADING

EVALUATION CRITERIA

The graded assignments will be evaluated using the following weighted categories:

Category	Weight
Discussion	10%
Exercise	20%
Lab	35%
Project	20%
Final Exam	15%
TOTAL	100%

GRADE CONVERSION

The final grades will be calculated from the percentages earned in the course, as follows:

Grade	Percentage
A (4.0)	90–100%
B+ (3.5)	85–89%
B (3.0)	80–84%
C+ (2.5)	75–79%
C (2.0)	70–74%
D+ (1.5)	65–69%
D (1.0)	60–64%

F	(0.0)	<60%

LEARNING MATERIALS AND REFERENCES

REQUIRED RESOURCES

COMPLETE TEXTBOOK PACKAGE

- Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D. (2013). *8051 Microprocessors and embedded systems with lab manual* (Custom ed.). Boston, MA: Pearson Custom.

OTHER ITEMS

- Student Toolkit

RECOMMENDED RESOURCES

- Books and Professional Journals
  - Pont, M. (2005). *Embedded C*. Upper Saddle River, NJ: Pearson Educational Limited.
  - Schultz, T. (2008). *C and the 8051* (4th ed.). Ostego, MI: Wood Island Prints.
- ITT Tech Virtual Library (accessed via Student Portal | https://studentportal.itt-tech.edu)
  - Browse> Browse by Format> Books> Books24x7>
    - Labrosse, J. (2002). *Embedded systems building blocks* (2nd ed.). San Francisco, CA: CMP Books.
    - Williams, R. (2006). *Real-time systems development*. Burlington, MA: Butterworth-Heinemann.
  - School of Study> School of Electronics Technology> Recommended Links> Components>
    - The Online 8052 Resource
  - School of Study> School of Electronics Technology> Recommended Links> Online Magazines and Journals>
    - EE TIMES Online
  - School of Study> School of Electronics Technology> Recommended Links> Product and Data Sheet Directories>
    - EE Times: Product parts search

- Other References
    - Circuit Cellar | Microcontrollers, Embedded Systems, & Electrical Engineering Information
      http://www.circuitcellar.com (accessed on 9/30/14)

Great microcontroller articles, contests and fun.

    - How to Use Keil Microvision IDE Create a project 8051 Microcontroller Projects AVR PIC Projects Tutorials Ebooks Libraries codes

http://www.youtube.com/watch?v=gXXo_4m46qY (accessed on 9/30/14)

    - Keil 8051 Development Tools
      http://www.keil.com/c51 (accessed on 9/30/14)

Website provides development tools for the 8051 microcontroller.

    - Projects—Free 8051 Microcontroller Projects
      http://www.8051projects.info/projects.asp (accessed on 9/30/14)

Website contains the projects, datasheets, tutorials, and code library for the 8051 microcontroller.

INSTRUCTIONAL METHODS AND TEACHING STRATEGIES

The curriculum employs a variety of instructional methods that support the course objectives while fostering higher cognitive skills. These methods are designed to encourage and engage you in the learning process in order to maximize learning opportunities. The instructional methods include but are not limited to lectures, collaborative learning options, use of technology, and hands-on activities.

To implement the above-mentioned instructional methods, this course uses several teaching strategies, such as hands-on labs, exercises, and discussions. Your progress will be regularly assessed through a variety of assessment tools including discussions, exercises, labs, project, and the final exam.

OUT-OF-CLASS WORK

For purposes of defining an academic credit hour for Title IV funding purposes, ITT Technical Institute considers a quarter credit hour to be the equivalent of: (a) at least 10 clock hours of classroom activities and at least 20 clock hours of outside preparation; (b) at least 20 clock hours of laboratory activities; or (c) at least 30 clock hours of externship, practicum or clinical activities. ITT Technical Institute utilizes a “time-based option” for establishing out-of-class activities which would equate to two hours of out-of-class activities for every one hour of classroom time. The procedure for determining credit hours for Title IV funding purposes is to divide the total number of classroom, laboratory, externship, practicum and clinical hours by the conversion ratios specified above. A clock hour is 50 minutes.

A credit hour is an artificial measurement of the amount of learning that can occur in a program course based on a specified amount of time spent on class activities and student preparation during the program course. In conformity with commonly accepted practice in higher education, ITT Technical Institute has institutionally established and determined that credit hours awarded for coursework in this program course (including out-of-class assignments and learning activities described in the “Course Outline” section of this syllabus) are in accordance with the time-based option for awarding academic credit described in the immediately preceding paragraph.

ACADEMIC INTEGRITY

All students must comply with the policies that regulate all forms of academic dishonesty or academic misconduct. For more information on the academic honesty policies, refer to the Student Handbook and the School Catalog.

INSTRUCTOR DETAILS

Instructor Name	
Office Hours	
Contact Details	

(End of Syllabus)