ITT Technical Institute

ET355

Microprocessors

Onsite Course

SYLLABUS

Credit hours: 4

Contact/Instructional hours: 50 (30 Theory Hours, 20 Lab Hours)

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

Prerequisite: ET285 Digital Electronics II

Course Description:

Students study the architecture, interfacing and programming of a microprocessor, including interfacing the microprocessor with memory and with input and output devices. In lab, students will write, run and debug programs.

Syllabus: Microprocessors

Instructor:	_____
Office hours:	_____
Class hours:	_____

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 Objectives

1. Describe contemporary wide-ranging microprocessor and microcontroller product applications.
2. Use numerical methods for processor-based systems to perform calculations and conversions related to programming.
3. Examine practical programming considerations encountered in real applications.
4. Draw and label block diagrams of microcontrollers showing the arithmetic logic unit (ALU), internal bus structure, and registers and peripheral function blocks.
5. Select a processor addressing mode for a given scenario.
6. Apply common processor instructions in programs to demonstrate how they operate.
7. Describe the essential processor control, data, and address buses elements and timing cycles.
8. Demonstrate the processes of creating, assembling, and programming microcontrollers.
9. Examine fundamental processor I/O interfacing methods.
10. Explain how function block features and interrupt usage are used in designing products.
11. Demonstrate how to break down embedded projects into separable software tasks and hardware functions.
12. Use simulation and debugging techniques to verify software is operational.
13. Demonstrate the ability to use oscilloscopes, other test equipment, and external inputs for troubleshooting and verification purposes.
14. Plan, design, implement, and debug at least one functional microcontroller student project.

SCANS Objectives

SCANS is an acronym for Secretary's Commission on Achieving Necessary Skills. The committee, created by the National Secretary of Labor in the early 1990s, created a list of skills and competencies that the committee feels are necessary for employees to function in a high-tech job market.

1. Competently perform the tasks of acquiring data and evaluating information to determine specific information needs.
2. Determine which set of procedures, tools, or machines will produce the desired results.

3. Demonstrate competence in applying technology.
4. Approach practical problems by choosing appropriately from a variety of mathematical techniques.
5. Understand the overall intent and the proper procedures for setting up and operating machines.
6. Organize and process symbols, pictures, graphs, objects or other information.

Course Outline

Note: All graded activities, except the Project and Final Exam, are listed below in the pattern of <Unit Number>.<Assignment Number>. For example, Lab 10.2 refers to the 2nd lab activity in Unit 10.

Unit	Activities
1— Introduction to the Microprocessor Era	• Content Covered: *Microprocessors: Student Book & Lab Manual*: o Chapter 0, “Introduction to Computing” o Chapter 1, “The 8051 Microcontrollers” o Chapter 2, “8051 Assembly Language Programming,” pp. 37-51 o Appendix I, “Basic ProView Software Tutorial” o Appendix J, “Basic Tutorial for Keil Software” o Appendix K, “How to Test, Download, and Run a Program on the MDE 8051 Trainer Board” • Assignments: 1.1 • Labs: 1.1
2— Processor Programming Concepts—Basic Control	• Read from *Microprocessors: Student Book & Lab Manual*: o Chapter 2, “8051 Assembly Language Programming,” pp. 52-63 o Chapter 3, “Jump, Loop, and Call Instructions” o Chapter 4, “I/O Port Programming,” pp. 93-99 o Chapter 8, “8051 Hardware Connection and Intel Hex File,” pp. 224-231 o Appendix O: RISC and Harvard Architectures • Assignments: 2.1, 2.2 • Quizzes: 2.1 • Labs: 2.1
3— Basic I/O and Addressing Concepts	• Read from *Microprocessors: Student Book & Lab Manual*: o Chapter 4, “I/O Port Programming,” pp. 100-106 o Chapter 5, “8051 Addressing Modes” • Assignments: 3.1 • Labs: 3.1
4— Logic and Numerical Methods	• Read from *Microprocessors: Student Book & Lab Manual*: o Chapter 6, “Arithmetic & Logic Instructions and Programs” o Chapter 7, “8051 Programming in C,” pp. 181-188 • Assignments: 4.1 • Quizzes: 4.1 • Labs: 4.1
5— Advanced I/O Techniques	• Read from *Microprocessors: Student Book & Lab Manual*: o Chapter 8, “8051 Hardware Connection and Intel Hex File,” pp. 217-223 o Chapter 14, “8051 Interfacing to External Memory,” pp. 411-440 o Chapter 17, “Motor Control: Relay, PWM, DC, and Stepper Motors,” pp. 491-515

Unit	Activities
	○ Appendix M “SPI Bus” ○ Appendix N, “I2C Bus” • Assignments: 5.1 • Exams: 5.1 • Labs: 5.1
6— Exploring Timer Functions	• Read from *Microprocessors: Student Book & Lab Manual*: ○ Chapter 9, “8051 Timer Programming in Assembly and C,” pp. 239-260 • Assignments: 6.1, 6.2 • Project (Submit Student-Selected Project proposal) • Quizzes: 6.1 • Labs: 6.1
7— Using Serial Communications	• Read from *Microprocessors: Student Book & Lab Manual*: ○ Chapter 10, “8051 Serial Port Programming in Assembly and C,” pp. 277-305 • Assignments: 7.1 • Labs: 7.1
8— Interrupts and Polling Methods	• Read from *Microprocessors: Student Book & Lab Manual*: ○ Chapter 11, “Interrupts Programming in Assembly and C” • Assignments: 8.1 • Exams: 8.1 • Labs: 9.1
9— Keypad and Display Interfacing	• Read from *Microprocessors: Student Book & Lab Manual*: ○ Chapter 12, “LCD and Keyboard Interfacing” • Assignments: 9.1 • Project (Student-Selected Project summary of progress) • Quizzes: 9.1 • Labs: 9.1
10— Working with A/D and D/A Conversions	• Read from *Microprocessors: Student Book & Lab Manual*: ○ Chapter 13, “ADC, DAC, and Sensor Interfacing” ○ Appendix L, “AVR Microcontrollers: History and Features” • Assignments: 10.1 • Labs: 10.1, 10.2
11— Course Review and Final Exam	• Final Exam • Project: Student-Selected Project submitted and presented OR In-lab Final Project

Instructional Methods

This course incorporates learning strategies such as quizzes, homework assignments, lab exercises, exams, a project, and a final exam. These help you understand and demonstrate the concepts taught in class.

Every unit includes a homework assignment, which is based on the unit’s course objectives, and you will submit them to your instructor during the following unit. A quiz will be given roughly every other unit, evaluating the previous unit’s course objectives. Quizzes help you to analyze your learning and recall of previously taught concepts. Additionally, lab exercises reinforce theory and develop your embedded systems skills through simulating, programming and/or constructing processor circuits.

Exams, a final exam, and a project are designed to evaluate your understanding of the core concepts covered in this course.

Instructional Materials and References

Student Textbook Package
Mazidi, Muhammad Ali, Janice Mazidi, and Rolin McKinlay. *Microprocessors: Student Book & Lab Manual*. Custom 2nd ed. Upper Saddle River, NJ: Prentice Hall, 2009.

Other Required Resources

In addition to the student textbook package, the following is also required in this course:

- Computer and Electronics Engineering Technology (CEET) Second Year Parts Kit

References

ITT Tech Virtual Library

Log on to the ITT Tech Virtual Library at http://www.library.itt-tech.edu/ to access online books, journals, and other reference resources selected to support ITT Tech curricula.

Books

You may click “Books” or use the “Search” function on the home page to find the following books.

- Williams, Rob. *Real-Time Systems Development*. Burlington, MA: Butterworth-Heinemann, 2006.
  - Chapter 18

Periodicals

You may click “Periodicals” or use the “Search” function on the home page to find the following periodicals.

- Electronics Design
- Electronics Weekly
- ECN: Electronic Component News

Reference Resources

You may click “Reference Resources” or use the “Search” function on the home page to find the following reference resources.

- EG3.com

Program Links

You may click “Program Links” or use the “Search” function on the home page to find the following program links.

- Recommend Links
  - Components> The Online 8052 Resource
  - Product and Data Sheet Directories> EE Product Center
  - Programmable Logic Controllers> The Learning Pit: PLC Simulators and Resources for Training
  - Programmable Logic Controllers> PLCS. Net

Other References

The following resources may be found **outside** of the ITT Tech Virtual Library, whether online or in hard copy.

Books

- Ganssle, Jack. *The Art of Designing Embedded Systems*. 2nd ed. Burlington, MA: Elsevier, 2008.
- Schultz, Thomas. *C and the 8051*. 4th ed. Wood Island Prints, 2008.

Periodicals

- www.circuitcellar.com

Circuit Cellar

Filled with processor knowledge and projects, this magazine conducts yearly big-money contests for student projects.

- http://www.embedded.com

Home of *Embedded Systems Programming* Magazine

This magazine provides up-to-date information on what's new in the embedded processor world.

Web sites

- http://www.keil.com/c51/

C51 Development Tools

This Web site provides development tools for the 8051 microcontroller, including compilers, assemblers, and product manuals.

- http://www.hobbyprojects.com/microcontroller_tutorials.html

Hobby Projects: Microcontroller Tutorials

This Web site provides a tutorial for the 8051 microcontroller.

- http://www.edsim51.com/

EdSim51

This Web site provides a free downloadable 8051 simulator.

- http://www.8051projects.info/projects.asp

8051 Projects

This Web site contains free projects, datasheets, tutorials, and code library for the 8051 microcontroller.

- http://www.avrfreaks.net

Atmel AVR Projects

This Web site contains data, student projects, tutorials, and examples using Atmel AVR processors.

- http://www.digikey.com

Parts Source

This Web site is an industry source for parts.

- http://amasci.com/supliers.html

Surplus Parts Sources

This Web site provides a wide variety of surplus and very low-cost parts for your projects.

All links to Web references outside of the ITT Tech Virtual Library are always subject to change without prior notice.

Course Evaluation and Grading

Evaluation Criteria Table

The final grades will be based on the following categories:

CATEGORY	WEIGHT
Assignments	15%
Quizzes	10%
Labs	30%
Project	10%
Exams	20%
Final Exam	15%
Total	**100%**

Note: Students are responsible for abiding by the Plagiarism Policy.

Grade Conversion Table

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

A	90–100%	4.0
B+	85–89%	3.5
B	80–84%	3.0
C+	75–79%	2.5
C	70–74%	2.0
D+	65–69%	1.5
D	60–64%	1.0
F	<60%	0.0

(End of Syllabus)