Syllabus
Engineering Technology
University of North Texas
Course Title: Embedded Controller
Organization
Course Prefix and Course Number:
MSET 5300
Semester: FALL 2016

The Engineering Technology Department, in cooperation with the Office of Disability Accommodation, complies with the Americans with Disabilities Act in making reasonable accommodations for qualified students with disabilities. Please present your written accommodation request to the instructor prior to the fourth day.

SAFETY CATEGORY: 1
DATE PREPARED: August 23, 2016.
PREPARED BY: Dr. Elias Kougianos

COURSE NUMBER, TITLE, CREDIT HOURS:
MSET 5300 – Embedded Controller Organization, 3 (3; 0) Credit Hours.

DESCRIPTION:
The study of the technical aspects of real-time software systems: software development methodologies, operating system and real-time kernel concepts.

PREREQUISITES:
B.S. in Engineering or ETEC or Physics, and knowledge of structured programming and digital logic.

CLASS VENUE:
The class meets twice a week: on Tuesdays and Thursdays at 11:30 AM – 12:50 PM in room F183 (Analog Lab) Discovery Park. The course will be managed via UNT’s Blackboard Learn system:
https://learn.unt.edu

REQUIRED TEXTBOOKS:
- The electronic version of the book costs $9.95 and can be purchased from Amazon. A printed version is also available from Amazon for $19.00.
- One of these editions is required. There will be an additional low-priced textbook which will be published in September and will be used in the second part of the course.

SUPPLEMENTAL TEXTS AND MATERIALS:
Various supplements will be provided during the course and will be available on Blackboard.

There are no hardware requirements for the course. However, it is strongly recommended that you purchase the TI MSP432 Launchpad ($12.99) for your own personal use. It is not required for the course.
To be able to follow the examples you must have the Keil Microcontroller Development Kit (MDK) installed on your personal computer. The evaluation version is free and sufficient for our purposes.

**COURSE OBJECTIVES:** (TAC of ABET Criteria and Program Educational Objectives supported)

a) Understand microcontroller technology. (1,2,5,6)
b) Understand the programming concepts and languages used to instruct microcontrollers. (1,2,3,4,6,8)
c) Understand how to use registers and memory. (1,2,3,6)
d) Understand the chip operation, including the system bus, operating modes, clocked operation, and memory technology. (1,2,3,6)
e) Understand subsystems for parallel, serial, programmable timer and analog interfacing. Some common hardware designs are introduced to interface the microcontroller to sensors and actuators. (1,2,5,6,8,11)
f) Understand how programs use the subsystems for control application. (1,2,5,6,8,11,14,15,16)

**STUDENT LEARNING OUTCOMES:** (Course Objectives Supported)

Graduate students will be able to:

1) Adequately understand the assembly language programming of various microcontrollers. (2,6)
2) Be proficient in implementing the design and interfacing of microprocessor-based systems. (3,5,6)
3) Be proficient in writing assembly language programs to control I/Os. (2,5,6)
4) Be proficient in utilizing microprocessor ports in the semester project. (1,2,3,4,5,6)
5) Adequately understand communication techniques with microcontrollers. (5)
6) Adequately understand how to perform real time interfacing of microcontrollers. (a,b,c,d,e,f)

**GRADING ELEMENTS AND WEIGHTS:**

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Midterm Tests (2)</td>
<td>60% (30% each)</td>
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<tr>
<td>Final exam</td>
<td>40%</td>
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<tr>
<td><strong>maximum:</strong></td>
<td>100%</td>
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Grading Scale: (based on total course points)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>90% &amp; up</td>
</tr>
<tr>
<td>B</td>
<td>80 - 89.99%</td>
</tr>
<tr>
<td>C</td>
<td>70 - 79.99%</td>
</tr>
<tr>
<td>D</td>
<td>60 - 69.99%</td>
</tr>
<tr>
<td>F</td>
<td>0 - 59.99%</td>
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NOTES:
The exam schedule is as follows:
Test 1 is on Thursday October 6th (week 6).
Test 2 is on Thursday November 17th (week 12)
The final exam will take place on Tuesday, December 13th 10:30AM-12:30PM, in Room F183.

You will have full access to the course web site during all tests (including the final) but limited access to the internet.
You will not be allowed open textbooks or notes.

During tests the use of electronic devices such as cell phones, smart phones, smart watches, pagers, photographic devices and/or other electronic or communication devices is strictly prohibited. Such devices must be turned off during the tests.

LEARNING STRATEGIES:

This is a lecture course. The instructor will give explanatory lectures, and students will perform hands-on tasks during the lecture. Furthermore, sample problems illustrating the points of the lecture will be solved during the lecture.

COURSE OUTLINE:

I. BASIC STRUCTURE OF COMPUTERS
   A. Computer Types
   B. Functional Units
   C. Basic Operational Concepts
   D. Performance
   E. Historical Remarks

II. INSTRUCTION SET ARCHITECTURE
   A. Memory Locations and Addresses
   B. Memory Operations
   C. Addressing Modes
   D. Assembly Language
   E. Stacks & Subroutines
   F. RISC & CISC

III. BASIC INPUT/OUTPUT
   A. Accessing I/O Devices
   B. Interrupts

IV. SOFTWARE
   A. The Assembly Process
   B. Loading and Executing Object Programs
C. The Linker
D. Libraries
E. The Compiler
F. The Debugger
G. Interaction Between Assembly Language and C
H. The Operating System

V. BASIC PROCESSING UNIT
   A. Fundamental Concepts
   B. Instruction Execution
   C. Hardware Components
   D. Control Signals
   E. Hardwired Control
   F. CISC Processors

VI. INPUT/OUTPUT ORGANIZATION
   A. Bus Structure
   B. Bus Operation
   C. Arbitration
   D. Interface Circuits
   E. Interconnection Standards

VII. THE MEMORY SYSTEM
    A. Read-Only Memories
    B. Direct Memory Access
    C. Memory Hierarchy
    D. Cache Memories
    E. Performance
    F. Virtual Memory
    G. Secondary Storage.

VIII. EMBEDDED SYSTEMS
     A. Examples of Embedded Systems
     B. Microcontrollers
     C. A Simple Microcontroller
     D. A Complete Example: A Reaction Timer
     E. Sensors and Actuators
     F. Microcontroller Families
     G. Design Issues

IX. SYSTEM-ON-A-CHIP -- A CASE STUDY
    A. FPGA Implementation
    B. CAD Tools
    C. Alarm Clock Example
CLASS POLICIES:
1. All rules relating to academic dishonesty will be enforced in accordance with University policies.
2. State common law and federal copyright laws protect my lectures. They are my own original expression and I record them at the same time that I deliver them in order to secure protection. Whereas you are authorized to take notes in class thereby creating a derivative work from my lecture, the authorization extends only to making one set of notes for your own personal use and no other use. You are not authorized to record my lectures, to provide your notes to anyone else or to make any commercial use of them without expressed prior permission from me.
3. This syllabus is subject to change at any time during the semester with changes to be announced in class.
4. Students should schedule at least one hour per lecture hour for study outside class. Students should schedule at least one hour per laboratory hour for outside work to prepare for the laboratory, use of open laboratory hours, and to complete the required laboratory documentation.
5. Grades are based, in part, on the student's ability to communicate. Well written English is expected in all course work and is a factor in laboratory report grades. The student’s ability to orally communicate the results of laboratory exercises and class assignments is also monitored.
6. Each student should retain graded lecture notes, pop quizzes, homework, tests, software-generated files, and laboratory reports to document errors in recorded grades.
7. Requests for review of graded work must be submitted during the lecture in which such work is returned to the students. The request should be accompanied by a written justification of the request including any supporting data.
8. The UNT Catalog procedures on cheating and plagiarism will be vigorously enforced. It is the duty of all students to protect their work so it is not available to others for submission as their efforts. This is especially true of files that are generated on the computer. Students who knowingly allow others to use their work are partners in this unethical behavior.
9. There is no limit to the use of calculators for lecture, labs, pop quizzes, formal tests, or final examination.
10. Challenges to the course grade must be presented within 60 days of receipt of grade notices mailed by the university. This will insure that instructor’s records are still available to allow a review of the assigned grade. You should first discuss your complaint with the instructor. If you wish to carry it further, contact the Program Coordinator by calling (940) 565-2022. To further pursue your complaint, contact the Department Chair at (940) 565-2022, but ONLY after first discussing your concern with the previous two individuals.
11. If appropriate, Material Safety Data Sheets (MSDS) are maintained on file in the department for your review. Access to these documents may be provided by the:
   • instructor of this course,
   • Program Coordinator, or
   • Department Secretary.
Seek initial access through the instructor or Coordinator rather than the secretary.

12. Cheating on quizzes, examinations and laboratory assignments, and plagiarism on various papers and reports are types of disciplinary misconduct for which penalties are assessed under the UNT Code of Student Conduct and Discipline. Major responsibility for implementing the University's policy on scholastic dishonesty rests with the faculty. Be advised that the instructor of this course supports and fully implements this policy. The following actions will be taken when evidence of such misconduct is observed. The student will be presented with the evidence of misconduct and given an opportunity to explain same. Based on the outcome of this private conference, the matter will be either dropped or the student will be given a grade of "F" in the course and be referred to the Dean of Students for further counseling and/or disciplinary action.

13. An I (incomplete) grade is given only for extenuating circumstances and in accordance with University and Departmental Policies.

DISABILITIES ACCOMODATION
The University of North Texas complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. The University of North Texas provides academic adjustments and auxiliary aids to individuals with disabilities, as defined under the law. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring accommodation, please see the instructor and/or contact the Office of Disability Accommodation at 940-565-4323 during the first week of class.

COMPUTER USAGE:
Students are required to prepare designs using computer aided engineering software; run design simulations; prepare reports; and conduct internet research on the computer and associated equipment.
This course provides opportunities for students to take advantage of one or more of several software packages supported by the department in the classroom or in lab experiments, in simulation studies, homework assignments, or in projects.

COURSE EVALUATION:
The Student Evaluation of Teaching Effectiveness (SETE) is a requirement for all organized classes at UNT. This short survey will be made available to you at the end of the semester, providing you a chance to comment on how this class is taught. I am very interested in the feedback I get from students, as I work to continually improve my teaching. I consider the SETE to be an important part of your participation in this class.

LIBRARY USAGE:
Students will do a library search about embedded microcontrollers and real time programming for the lecture part.