DeVRY UNIVERSITY

Course Syllabus **Summer 2007**

Course Title:	Embedded Microprocessor Systems
Course number:	EET387
Credit/Contact hour:	3-0-3
Course Dependency:	**Prerequisite:** EET344, EET240 (Solid State), COMP270 (C/C++) **Required Co-requisite**: (none)
Class Schedule:	
Instructor:	Tom Wheeler E-mail: twheeler@devry.edu Voice Mail: 816.941.0430 x5211
Office Hours:	Wed 12-12:50 pm; Thur 12-12:50 pm; Fri 2-2:50 pm Other times possible by appointment

Course Description

In this course students explore hardware and software to analyze and design an embedded microprocessor system. Microcontroller and computer-aided tools are used for designing systems, and practical debugging and troubleshooting methods are emphasized. The C programming language is used as the development platform. The development cycle of complete systems will be emphasized, including the debugging cycle, hardware interfacing and device driver development, user interfaces, and peripheral interfacing using the various features of the ATMEGA16 microcontroller.

Textbooks and Materials (Bring these to EVERY class)

Textbook/s Title:	**Ed**	**Author**
Embedded C Programming and the ATMEL AVR (Thompson-Delmar Learning)	**1st**	Barnett, Cox, and O'Cull
ATMEGA16 Datasheet	**Current**	ATMEL Corporation

Useful Resources

You'll find a number of very useful resources on the instructor's web site (http://faculty.kc.devry.edu). Some of these will be made available on CD-ROM:

- Video to walk you though the CodeVisionAVR environment showing how to compile, debug, and execute a sample C project on the ATMEGA16.
- Video demonstrations of several of the laboratory projects.
- Design details (including Eagle CAD files) for construction of a JTAG-to-ATMEGA16 adapter PC board, which eliminates the need to hand-wire the JTAG interface on the ATMEGA16.
- Sample code.
- Practice examinations to help you review and refine your knowledge of the C programming language.

Terminal Course Objectives (TCOs):

Following are the objectives for this course. Individual faculty, based upon their experience and expertise may add to these objectives to meet local campus needs. Any such additions will be communicated to the class. While the instruction remains focused in helping students, accomplishing these objectives is a shared responsibility of students and faculty. The outcomes of this course will depend upon the motivation and capabilities of the students, sufficient time allocation for studying, and the effectiveness of that effort.

DeVry University is committed to the continual improvement of its curriculum and instruction and to meet the needs of students and employers in a rapidly changing global economy. Students, faculty, and the university must all be actively involved to accomplish these objectives, as well as the objectives of this particular course.

Every class is to some extent a unique interactive experience, which may cause some variance within the stated objectives, in either content or level. Individual faculty, based on their experience and expertise, are encouraged to add objectives, as they deem appropriate, and to communicate these directly to the class. The outcomes of the course will depend on the design of the course, the quality of instruction, and the motivation and capabilities of the students, including time available for studying and the effectiveness of the effort.

1. Given a number of popular microcontrollers such as the 8051, 62HC11 and PIC16F84, write a brief research paper which compares and contrasts the architectures, features and capabilities.
2. Given an applications problem, recommend a particular microcontroller solution and prepare a brief oral presentation which justifies the recommendation.
3. Given a simple application such as event sequencing, develop an assembly language solution which satisfies all functional and performance requirements. Include configuration and initialization, arithmetic and logical operations, decision making and I/O.
4. Given a timing application such as keyboard debounce or pattern generation and detection, write and document an assembly language program which uses programmable timers to satisfy functional and performance requirements, using accepted programming and documentation practices.
5. Given the requirements for a display subsystem, develop a complete embedded microcontroller solution, including hardware and software.
6. Given an applications problem such as data acquisition, develop a microcontroller-based software solution which uses both assembler and a higher level language such as C or C++.
7. Given a design documentation package including specifications, schematics and analysis results, plan and execute a hardware/software design review including a number of the students in the class.
8. Given an application such a digital-to-analog conversion, evaluate the advantages and disadvantage of a hardware solution versus an microcntroller (software) solution. Implement a complete microcontroller solution, including hardware, software, and documentation.
9. Given an application such as a data acquisition problem, prescribe a high-level embedded micrcontroller solution in terms of the following design specifications: hardware requirements, software requirements and interface requirements.
10. Document achievement of at least one Lab or Lecture Class TCO with a formal written report and/or an oral presentation in accordance with prescribed guidelines.

How this Course helps in Achieving Your Program's Objectives:

The following matrix illustrates how this course supports achievement of your Program Objectives.

EET387

Assessment Outcomes

Lecture	*Testing* & Instrumentation					*Create/Implement Programming*				*Hardware/Software Design, Implem, & Eval*						*Writing Speaking*		*Team*		*Research Prob. Solv*		*Tech./Society Linkages*		
TCOs	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	7.3
1	X	X	X	X	X					X	X	X	X	X	X									
2	X	X	X	X	X					X	X	X	X	X	X									
3	X	X	X	X	X					X	X	X	X	X	X									
4	X	X	X	X	X					X	X	X	X	X	X									
5	X	X	X	X	X					X	X	X	X	X	X									
6	X	X	X	X	X					X	X	X	X	X	X									
7	X	X	X	X	X					X	X	X	X	X	X									
8	X	X	X	X	X					X	X	X	X	X	X									
9						X	X	X	X															

EET/CET Program Objectives and Outcomes:

(Student competencies achieved at the time of graduation)

1. Conduct experiments involving electronic systems using modern test equipment, interpret test results and use them to improve products or methodologies.
   - 1.1. Performs Needs Analysis – define the problem
   - 1.2. States goals and objectives of the experiment
   - 1.3. Identifies resources to conduct experiment (parts, equipment, data sheets, etc.)
   - 1.4. Develops a procedure and collect data using modern test equipment
   - 1.5. Analyzes test results and draw conclusions.

2. Create, implement high-level and Assembly language programs in support of technical activities.
   - 2.1. Analyzes the problem logically
   - 2.2. Designs the solution
   - 2.3. Implements the solution
   - 2.4. Tests and debugs the software

3. For EET: Use the principles of science, mathematics, and engineering technology to design, implement, and evaluate hardware and software solutions to complex technical problems,
   - 3.1. Selects and defines a meaningful problem taking safety, ethical, social, economic, and technical constraints into consideration.
   - 3.2. Devises process to solve problem
   - 3.3. Applies appropriate knowledge of scientific, mathematical, and engineering design tools toward the design and analysis of problem solutions.
   - 3.4. Identifies key issues in designing and building a prototype
   - 3.5. Builds, tests and troubleshoots prototype
   - 3.6. Optimizes prototype with a commitment to quality, timeliness, and continuous improvement.

For CET: Use the principles of science, mathematics, software engineering, and engineering technology to design, implement, and evaluate software solutions to complex technical problems.
   - 3.1 Identifies a meaningful problem and defines preliminary solution specifications taking safety, ethical, social, economic, technical constraints, and user requirement into consideration
   - 3.2 Designs and implements appropriate data structures and algorithms
   - 3.3 Prepares a plan of action to implement the system
   - 3.4 Applies scientific, mathematical, software, and engineering design tools toward the design and analysis of problem solution
   - 3.5 Writes and tests readable and maintainable code
   - 3.6 Optimizes code with a commitment to quality, timeliness, and continuous improvement

4. Communicate effectively both orally and in writing.
   - 4.1 Communicates effectively in wiring
   - 4.2 Communicates effectively orally

5. Work effectively in a team environment.
   - 5.1 Exhibits good dialoguing skills
   - 5.2 As part of a small group project, when assigned roles, performs roles effectively

6. Apply applied research and problem-solving skills to support learning at DeVry as well as life-long personal and professional development.
   - 6.1 Recognizes the need to know information beyond one's own expertise and has the ability to gather and synthesize the necessary information into the solution of a problem
   - 6.2 Uses engineering problem-solving methodology in solving problems

7. Evaluate the broader effects of technology and to identify connections between technology and economics, politics, culture, ethical responsibility, social structure, the environment and other areas.
   - 7.1 Identifies linkages and causal relationships between technology and social, political, economic, cultural, and environmental conditions.
   - 7.2 Works effectively in diverse environments and adapts technical solution to solution a diverse audience
   - 7.3 Pursues technical work within guidelines for professional, ethical, and social responsibility

Class Policies and Procedures:

Attendance

Each student is required to attend every lecture and laboratory session in which he or she is enrolled. A swipe-card terminal (ATS) in each classroom is used to record attendance electronically. Students are responsible for arriving before class begins, sliding their identification card through the wall-mounted reader, and remaining for the duration of the course meeting. Students who are absent for two or more days should notify their Professor or assigned Academic Advisor in advance. Students who miss more than five (5) consecutive days of school are in violation of the DeVry attendance policy and will be dismissed. **Unexcused absence in excess of 5 hours will result in a reduction of the final course grade by one letter**.

Homework and Engineering Notebook Expectations

Homework (or the Engineering Notebook) is due at the beginning of class (xx00 UTC). *Late homework is not accepted unless mitigating circumstances are present (documentation will be required), and is not accepted more than one week past the due date.* Homework carries the weight of one major exam (100 points) in the course. Failure to do homework will do severe damage to your grade. (UTC=Universal Coordinated Time, or Standard World Time.)

Homework Performance Standards

- Unless specifically noted, all homework (including the Engineering Notebook) is to be done individually. If you need help solving a problem, it is acceptable to ask the instructor or a fellow student for assistance as long as you do your own work.

- For problems involving calculations, all work must be shown. If a numerical answer is obtained without doing a calculation, state clearly that this is the case. For example: "By inspection, the potential is 25 Volts."

- When showing work for numerical problems, all defining equations will be stated first. The last step in the problem will be substitution of values into the equations. For example:

  Given V = 20V and R = 5 Ohms, find the current I.

  $I = \frac{V}{R}$ (Comment: The defining equation, Ohm's law, is stated.)

  $I = \frac{20V}{5\Omega} = \underline{\underline{4A}}$ (Comment: Note that units are clearly displayed for the answer.)

- When a numerical answer is given, it must be boxed or underlined and have correct units attached.

- For program listings, your name must appear at the top of the listing. Each function must have a comment header stating the function name, purpose, arguments, and return conditions. Each major idea within the code must be properly commented.

- Programs that that lack appropriate division of functionality will receive a grade of zero (0). An example of such code would be a program performing all of its functionality within a single function such as main() when it would be more appropriate to divide the workload among several related functions.

(Homework Performance Standards are continued on next page)

Homework Performance Standards (Continued)

No credit will be given for any problems that have not been worked according to these instructions, or any additional instructions given by the instructor.

Homework will be kept in a 3-tab flexible folder, with the latest assignment in front. Your name, the course number, and the instructor's name must appear in clearly-readable form on the front of the folder.

Engineering Notebooks will be kept in a separate folder or ledger. It is permissible for the engineering notes to be hand-written (must be in ink). Date each page of the engineering notebook, and make sure your name, class section (EET387), and instructor's name appear on the front of the notebook. (If you miss a class, you are responsible for obtaining notes from a classmate and updating your own notebook.)

Make-Up Exams

No make up exams are given in EET387 for any reason.

Course Grading Standards

There are 2 major exams, an unspecified number of quizzes given at random intervals, various homework assignments, and a final examination given in the 15th week of the course. Your grade will be determined as follows:

2 Major Exams	200 points (18% each, 36% total)
Quizzes/Homework/ Engineering Notebook	100 points (18%)
Labs	100 points (18%)
Final Exam	150 points (28%)
	550 points total for course

Note: No makeup exams are given. All examinations will be announced at least 1 week prior to administration. All students must take the final exam. A passing grade in lecture and laboratory is necessary in order to pass the course.

A final letter grade is to be awarded to each enrolled student in accordance with the 4.00 grading system shown below:

Letter Grade	*Percent of Total Points*	*Grade Points*
A	90 – 100%	4.00
B	80 – 89%	3.00
C	70 – 79%	2.00
D	60 – 69%	1.00
F	Below 60%	0.00

Academic Integrity Policy

Ideas and learning form the core of the academic community. In all centers of education, learning is valued and honored. No learning community can thrive if its members counterfeit their achievement and seek to establish an unfair advantage over their fellow students. The academic standards at DeVry are based on a pursuit of knowledge and assume a high level of integrity in every one of its members. When this trust is violated, the academic community suffers injury and must act to ensure that its standards remain meaningful. The vehicle for this action is the Academic Integrity Policy outlined in the *Student Handbook*.

The Academic Integrity Policy is designed to foster a fair and impartial set of standards upon which academic dishonesty will be judged. All students are required to read, understand, and adhere to these standards, which define and specify the following mandatory sanctions for such dishonest acts as copying, plagiarism, lying, unauthorized collaboration, alteration of records, bribery, and misrepresentation for the purpose of enhancing one's academic standing:

- The ***first recorded offense*** will result in the student receiving zero credit for the entire paper, exam, quiz, lab, homework assignment, or other graded activity in which the incident of academic dishonesty occurred. No partial credit may be given. Where the incident involved a graded assignment normally subject to a "drop" option, the student may not exercise that option.

- The ***second recorded offense*** will result in the student receiving a failing grade for the course in which the second offense occurs. The second offense need not be in the same course, program, or term as the first offense to invoke this sanction.

- The ***third recorded offense*** will result in the student being permanently expelled from the DeVry system. Again, the third offense need not be in the same course, program, or term as either the first or second offense to invoke the sanction.

Changes to Syllabus:

The contents of this syllabus are subject to change with appropriate notice to the students.

Weekly Course Schedule:

Week	Topics	TCO's	What's Due
1	Review of C/C++ Concepts; C environment in-vitro on a microcontroller; storage types, C pointers, libraries. Introduction to CodeVisionAVR Environment. System design concepts (PGA, ASIC, MCU).	1,2,3	
2	Behavioral specifications; simple port interfacing (displays, decoding, look-up tables); timing considerations.	2,3	
3	High-level I/O devices (LCD); common C strategies for communication and data management.	5	HW #1
4	High-level I/O devices (keyboards); scanning, debouncing, code translation, common C device management methods	4	
5	Exam #1		Notebook
6	Analog-to-digital conversion subsystem; analog signal conditioning, sampling theorem, practical application	8,9	
7	Serial communications; UART programming considerations; common strategies for serial communications	9	
8	Timer Applications: Counting internal and external events. Pulse Width Modulation. Designing isolated power control circuitry.	4	
9	Interrupt Processing. Structuring C interrupt service routines. Threading concepts and volatile storage.	3,4	HW #2
10	Exam #2		Notebook
11	Case Studies		
12	Case Studies		
13	Case Studies		
14	Wrap-up and prepare for final exam		Notebook

Note: Content of case studies of weeks 11-13 will be jointly determined by the instructor and class group. These studies will involve more advanced topics and are intended to illustrate typical system design strategies (such as signal conditioning, interfacing, UI and protocol design, and so forth).

"Notebook" above refers to your updated Engineering Notebook, which is to be kept up-to-date each day you attend the course.