Objectives:
Microprocessors and microprocessor based computer systems are used in modern electronic systems and instruments for communications, in data acquisition, management and processing, and in process control. This course offers the student an opportunity to study the internal structure of microprocessors and to learn how to utilize their power by programming and interfacing them with basic input and output peripherals. The use of microprocessors will be discussed and some practical design examples will be given. The main objectives of the course are to present the fundamental principles of microprocessor based systems, provide an introduction to hardware and software design concepts, and establish a foundation for further learning.

Contact Hours:
3 hours/week lecture, 3 laboratory hours/every other week, 0.5 courses

Prerequisites:
ECE2277

Antirequisites:
CS3350a/b

Restrictions:
Unless you have either the requisites for the course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from the course for failing to have the necessary prerequisites.

General Learning Objectives (CEAB Graduate Attributes)

<table>
<thead>
<tr>
<th>Knowledge Base</th>
<th>3/2</th>
<th>Use of Engineering Tools</th>
<th>3/1</th>
<th>Impact on Society and the Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Analysis</td>
<td>3/2</td>
<td>Individual and Team Work</td>
<td></td>
<td>Ethics and Equity</td>
</tr>
<tr>
<td>Investigation</td>
<td>3/2</td>
<td>Communication Skills</td>
<td></td>
<td>Economics and Project Management</td>
</tr>
<tr>
<td>Design</td>
<td>3/2</td>
<td>Professionalism</td>
<td></td>
<td>Life-Long Learning</td>
</tr>
</tbody>
</table>

Notation: $x/y$, where $x$ is the cognitive level (1: Remember, 2: Understand, 3: Apply) at which the attribute is assessed and $y$ is the academic level (1: Beginner, 2: Intermediate, 3: Advanced) at which the attribute is assessed.
Specific Learning Objectives:

1. Memory mapping
   a. Understand the concept of the memory map
   b. Distinguish between different memory types and their functions
   c. Synthesize Boolean logic circuits to decode bus addresses

2. Assembly language programming
   a. Understand the register transfer model of the microprocessor
   b. Understand and use the concepts of mnemonic, operand, instruction fetch, data fetch
   c. Understand and use parameter passing and procedure calls in the stack
   d. Understand and use diverse addressing modes in RISC
   e. Design and implement assembly language solutions to simple programming problems
   f. Understand high-level language interface to assembly

3. Peripheral interfacing
   a. Use load and store instructions to interface with hardware peripherals
   b. Analyze A/D converter circuits
   c. Design and implement software solutions to work with A/D, timing, communication and port peripherals.

4. Embedded systems design
   a. Implement both polled and interrupt-driven embedded control solutions
   b. Design an embedded control system beginning from user requirements, through part selection and detailed design
   c. Implement and debug prototype embedded solutions on provided hardware

5. Independent skills development
   a. Determine assembly language features from documentation
   b. Develop peripheral interface software based on peripheral specifications
   c. Select a microcontroller to meet a system requirement

Textbook:

References:
Daniel J. Pack and Steven F. Barrett, "Microcontroller Theory and Applications: HC12 & S12"

Daniel J. Pack and Steven F. Barrett, "68HC12 Microcontroller: Theory and Applications".


**CEAB Units:**
ES 75% ED 25%

**Assignments:**
Problems will be suggested during this course but will be not collected and graded. It is recommended that the student attempt these.

**Laboratories:**
The exercises will demonstrate the use of assembly language in programming, the use and interfacing of basic input/output devices and the fundamental concepts of hardware design.

**Design Project:**
The course will include a long-term, open-ended design project that focuses on real-world applications using microcontroller interfacing.

**Calculators and Personal Communications Devices:**
Only non-programmable calculators are permitted during tests and examinations. No other electronic device is permitted.
Attendance:
Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course. **Note that this means attendance in laboratories, and completion of each experiment, is mandatory.**

Cheating:
University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties which might include expulsion from the program. If you are caught cheating, there will be no second warning.

Plagiarism:
Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar). All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com ([http://www.turnitin.com](http://www.turnitin.com)).

Evaluation:
The final grade will be based on the result of a two-hour term test (approximately mid-term), a three-hour final examination during the examination period, one (or more) programming assignments and performance in the laboratory. The only aid permitted during tests and examinations will be a non-programmable calculator.

A grade of less than 50% on the final examination will result a final grade not greater than 48%. Students’ final grades will be computed according to the following two weighting schemes. Whichever scheme yields a HIGHER overall grade will be the recorded grade. The weights for the components are shown in the following table.

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight (A)</th>
<th>Weight (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm test</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Laboratory &amp; Programming Assignments</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Design Assignment</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Final Exam</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

*) In accordance with the policy of the University, the grade assigned to all written and oral work presented in English shall take into account syntax, diction, grammar and spelling. In the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of the undergraduate program. To encourage the student to do so, the grades assigned to all
written and oral work will take into account all aspects of presentation including conciseness, organization, neatness, use of headings, and the preparation and use of tables and figures. All work will be marked first for content after which a penalty not to exceed a maximum of 5% may be applied for lack of proficiency in English or presentation.

Faculty of Engineering Policy on Repeating All Components of the Course
Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

Missed Midterm Policy
If a student misses a midterm test, the test will not be rescheduled. The student must follow the Instructions for Students Unable to Write Tests and provide documentation to their Department within 24 hours of the missed test. The Department will decide whether to allow the reweighting of the test; the reweighting means the marks normally allotted for the test will be added to the final exam. In this situation, the weight of the final examination will be 80%; the weight of the laboratory will be 20%. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero on the test.

Accessibility

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Students that are in emotional/mental distress should refer to Mental Health @ Western, http://www.uwo.ca/uwocom/mentalhealth/, for a complete list of options about how to obtain help.

Mid Term Examination
TBA

Course Instructors:
Mr. T. Menkad and Dr. A. Reyhani-Masoleh

Consultation Hours:
By appointment.