

**WESTERN UNIVERSITY**  
**FACULTY OF ENGINEERING**  
**Department of Electrical and Computer Engineering**

**MICROPROCESSORS AND MICROCOMPUTERS (ECE 3375b)**  
***COURSE OUTLINE 2017-2018***

**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)**

Knowledge Base	3/2	Use of Engineering Tools	3/1	Impact on Society and the Environment	
Problem Analysis	3/2	Individual and Team Work		Ethics and Equity	
Investigation	3/2	Communication Skills		Economics and Project Management	

Design	3/2	Professionalism		Life-Long Learning	3/1
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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 CISC
- 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:

There is no assigned text. Course notes will be provided.

### References:

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

Pearson Prentice Hall Inc., New Jersey, 2008. [ISBN 978-0-13-615205-7]

Daniel J. Pack and Steven F. Barrett, "68HC12 Microcontroller: Theory and Applications". Prentice Hall Inc., New Jersey, 2002. [ISBN 0-13-033776-5]

Steven F. Barrett and Daniel J. Pack, "Embedded Systems: Design and Applications with the 68HC12 and HCS12". Prentice Hall Inc., New Jersey, 2004. [ISBN 0-13-140141-6]

Richard E. Haskell, "Design of Embedded Systems Using 68HC12/11 Microcontrollers. Prentice Hall, Inc., 2000.

Peter Spasov, "Microcontroller Technology: The 68HC11", Fourth Edition. Prentice Hall Inc., New Jersey, 2002.

Michael Kheir, "The M68HC11 Microcontroller: Applications in Control, Instrumentation, and Communication", Prentice Hall Inc., New Jersey, 1997.

Ronald J. Tocci and Frank J. Ambrosio, "Microprocessors and Microcomputers: Hardware and Software", Sixth Edition. Prentice Hall Inc., New Jersey, 2003.

Frederick F. Driscoll, Robert F. Coughlin and Robert S. Villanucci, "Data Acquisition and Process Control with the M68HC11 Microcontroller", Second Edition. Prentice Hall Inc., New Jersey, 2000.

Han-Way Huang, "MC68HC11 - An Introduction: Software and Hardware Interfacing". West Publishing Co., New York. 1996.

Frederick M. Cady and James M. Sibigroth, "Software and Hardware Engineering: Motorola M68HC12". Oxford University Press, New York, 2000.

**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>).

### **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.

Component	Weight (A)	Weight (B)
Midterm test	15	5
Laboratory & Programming Assignments	10	10
Design Assignment	15	15
Final Exam	60	70

\*) 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 Instructor:**

Dr. K. McIsaac.

[TEB265]

### **Consultation Hours:**

By appointment.

**INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED**

IF, ON MEDICAL OR COMPASSIONATE GROUNDS, YOU ARE UNABLE TO WRITE TERM TESTS OR FINAL EXAMINATIONS OR COMPLETE COURSE WORK BY THE DUE DATE, YOU SHOULD FOLLOW THE INSTRUCTIONS LISTED BELOW. YOU SHOULD UNDERSTAND THAT ACADEMIC RELIEF WILL NOT BE GRANTED AUTOMATICALLY ON REQUEST. YOU MUST DEMONSTRATE TO YOUR DEPARTMENT (OR THE UNDERGRADUATE SERVICES OFFICE) THAT THERE ARE COMPELLING MEDICAL OR COMPASSIONATE GROUNDS THAT CAN BE DOCUMENTED BEFORE ACADEMIC RELIEF WILL BE CONSIDERED. DIFFERENT REGULATIONS APPLY TO TERM TESTS, FINAL EXAMINATIONS AND LATE ASSIGNMENTS. PLEASE READ THE INSTRUCTIONS CAREFULLY. (SEE THE 2017 UWO ACADEMIC CALENDAR).

**A. GENERAL REGULATIONS & PROCEDURES**

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or exam that is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097. Otherwise, you will report to your department office to request relief.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your Department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

**B. TERM TESTS**

1. If you are in first year and you are unable to write a term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief. Otherwise, you will report to your department office to request relief.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling term tests.

**C. FINAL EXAMINATIONS**

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

**N.B. It is the student's responsibility to check the date, time and location of the Special Examination.**

**D. LATE ASSIGNMENTS**

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
  - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.
  - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.

## E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

## F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or Ms. Karen Murray in the Undergraduate Services Office, if you are in first year.

## G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

**In Case of Serious Illness of a Family Member:** Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**In Case of a Death:** Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**For Other Extenuating Circumstances:** If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

**Note:** Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

## H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

**Calendar References:** Check these regulations in your 2017 Western Academic Calendar available at [www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca).

Absences Due to Illness: <http://westerncalendar.uwo.ca/2017/pg117.html>

Academic Accommodations for Students with Disabilities: <http://westerncalendar.uwo.ca/2017/pg118.html>

Academic Accommodations for Religious or Holy Days: <http://westerncalendar.uwo.ca/2017/pg119.html>

Course Withdrawals: <http://westerncalendar.uwo.ca/2017/pg157.html>

Examinations: <http://westerncalendar.uwo.ca/2017/pg129.html>

Scheduling of Term Assignments: <http://westerncalendar.uwo.ca/2017/pg135.html>

Scholastic Offences: <http://www.westerncalendar.uwo.ca/2017/pg111.html>

Student Medical Certificate: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/medicalform.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)

Engineering Academic Regulations: <http://www.westerncalendar.uwo.ca/2017/pg1442.html>

**Note:** These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

### **Drop Deadlines:**

First term half course (i.e. "A" or "F"):	November 5, 2017
Full courses and full-year half courses (i.e. "E", "Y" or no suffix):	November 30, 2017
Second term half or second term full course (i.e. "B" or "G"):	March 7, 2017

### **Contact Information:**

Undergraduate Services Office:	SEB 2097	Telephone: (519) 661-2130	E-mail: <a href="mailto:engugrad@uwo.ca">engugrad@uwo.ca</a>
Dept. of Chemical and Biochemical Engineering & Green Process Engineering:	TEB 477	Telephone: (519) 661-2131	E-mail: <a href="mailto:cbeugrad@uwo.ca">cbeugrad@uwo.ca</a>
Dept. of Civil and Environmental Engineering:	SEB 3005	Telephone: (519) 661-2139	E-mail: <a href="mailto:civil@uwo.ca">civil@uwo.ca</a>
Dept. of Electrical and Computer Engineering, Software Engineering & Mechatronics Engineering:	TEB 279	Telephone: (519) 661-3758	E-mail: <a href="mailto:eceugrad@uwo.ca">eceugrad@uwo.ca</a>
Dept. of Mechanical and Materials Engineering:	SEB 3002	Telephone: (519) 661-4122	E-mail: <a href="mailto:mmeundergraduate@uwo.ca">mmeundergraduate@uwo.ca</a>