Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 3375B: Microprocessors and Microcomputers
Course Outline Winter 2022

Description: 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, introduce hardware and software design concepts, and establish a foundation for further learning.

Instructors: Dr. John McLeod
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Consultation hours: By appointment, via Zoom.

Dr. Arash Reyhani-Masoleh
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Consultation hours: By appointment, via Zoom.

Academic Calendar Copy: Basic elements of computers: central processing unit; memories; input/output devices; interfacing, software and hardware design, Computer Assisted Design; data handling and process control equipment; applications of microprocessors.

Contact Hours:
3 hours/week lecture, 1.5 laboratory hours, 0.5 course

Prerequisites:
ECE2277A/B

Antirequisites:
CS3350A/B

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.

CEAB Academic Units: Engineering Science 75%, Engineering Design 25%

Required Textbook: Dr. Yifeng Zhu, "Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C (Third Edition)"
ISBN-13: 978-0-9826926-6-0, Publisher: E-Man Press LLC; 3rd edition (July 2017)

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base		Use of Engineering Tools		**I?** Impact on Society and the Environment	
Problem Analysis		Individual and Team Work		Ethics and Equity	
Investigation	**I?**	Communication Skills		Economics and Project Management	
Design		Professionalism		Life-Long Learning	

Notation*: where x be I: Introductory, D: Intermediate, A: Advanced, or empty*. I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e.g. no review).

Course Topics and Specific Learning Outcomes	CEAB Graduate Attributes Indicators
1. Memory Mapping. At the end of this section, students will be able to: **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.** At the end of this section, students will be able to: **a.** Understand the register transfer model of the microprocessor. **b.** Understand and use the concepts of mnemonic, operand, instruction fetch, and data fetch. **c.** Understand and use parameter passing and procedure calls in the stack. **d.** Understand and use diverse addressing modes. **e.** Design and implement assembly language solutions to simple programming problems. **f.** Understand high-level language interface to assembly. **3. Peripheral Interfacing.**	

At the end of this section, students will be able to:

a. Use load and store instructions to interface with hardware peripherals.
b. Analyze analog-to-digital converter circuits.
c. Design and implement software solutions to work with A/D, timing, communications, and port peripherals.

4.   Embedded Systems Design.

At the end of this section, students will be able to:

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.

At the end of this section, students will be able to:

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.

Evaluation

Course Component	Weight
Homework Assignments	20%
Midterm test (OPTIONAL: see below)	15% / 0%
Laboratory & Programming Assignments	15%
Design Assignment	15%
Final Exam	35% / 50%

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination as well as on the laboratory. A final examination or laboratory mark < 50% will result in a final course grade of 48% or less.

Homework Assignments: Assignments will be regularly announced and posted on the course OWL site. Students must provide their answers on OWL as instructed on the assignment and by the posted due date. These assignments will be problem based.

Laboratory and Programming Assignments: 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. Lab work may be conducted on physical hardware in-

person in the design laboratory, or remotely using an online simulator, depending on the required COVID-19 safety precautions.

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

Midterm Test: The midterm test will be scheduled during the regular academic term; the exact date will be determined later. Students will be notified of the test date through the course OWL site in advance. The midterm test will be a take-home, open-book test. It will be distributed through the course OWL site. Students must be prepared to submit answers online, upload a digital version of their answers to the course OWL site within a predetermined time window. The midterm test is **optional**, if students do not complete the midterm, that portion of their grade will be added to the final examination.

Final Examination: The final examination will take place during the regular examination period, as scheduled by the registrar. As of writing this course outline, Western University expects in-person exams to resume, but the situation is uncertain. If in-person exams are held, the final examination will be an in-person, closed-book test. If remote exams are held instead, the final exam will be a take-home, open-book test distributed through OW. Updates on the format of the final exam will be provided over OWL. If the exam is conducted remotely, students must upload a digital version of their answers to OWL within a predetermined time window. Regardless of the format, the final examination will cover all content discussed in the lessons. If a student receives a higher grade on their final exam than on their midterm exam, the midterm grade will be discarded, and the final exam grade will be used in its stead.

Online Activities: This course will be delivered online for at least the first few weeks. All lecture material will be available on OWL as written notes and as short pre-recorded videos. The format of the course site on OWL will guide the students through the course material. Live tutorial sessions will be conducted using Zoom.

Students must have access to a computer/laptop/tablet that can regularly access OWL and can run Zoom (free with Western ID, Zoom runs on Windows, OSX, and Linux). A webcam and microphone are recommended for participating in live tutorials or for individual consultation with the instructor or TAs.

Students must be prepared to upload assignments, laboratory reports, formal reports and their answers to the examinations to OW. This may require a digital scanner or camera to capture material written on paper, or students may prepare their answers entirely electronically (typeset or using a touchscreen and stylus). It is each student's responsibility to determine a method of digitizing their submissions that is reliable and legible.

If in-person lessons resume, then lectures will be held in classrooms as scheduled by the registrar. However pre-recorded videos and written notes will still be available on OWL.

Recording Online Activities: Any live Zoom sessions for this course may be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals participating in the course for their private or group study purposes. Please contact the instructor if you have any concerns related to session recordings. Participants in this course

are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Individual consultations with the course instructor or TAs will not be officially recorded. Students may choose to make a personal recording of the session for study/review later, but public distribution of these recordings is not permitted.

Use of English: 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.

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.**

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached "Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled"). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, seethe relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Missed Lab: If a student misses a laboratory submission deadline and receives academic accommodation, they are responsible for contacting the instructor within 48 hours to arrange a new submission deadline. After this period, the student will receive a grade of zero for the exercise if the lab submission is not rescheduled.

Self-Reported Absences: Given the options for asynchronous course delivery regarding most assessment items, a self-reported absence is generally **not** an excuse for failing to complete an assessment. At best, a self-reported absence is grounds for waiving the late submission penalty of that assessment for 48 hours.

Cheating and 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. 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.

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 on 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).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

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.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (https://owl.uwo.ca/portal/) and making themselves aware of any information that is posted about the course.

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 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services:
> Office of the Registrar, http://www.registrar.uwo.ca/
> Student Development Centre, http://www.sdc.uwo.ca/
> Engineering Undergraduate Services, http://www.eng.uwo.ca/undergraduate/
> USC Student Support Services, http://westernusc.ca/services/

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