1 INSTRUCTIONAL SUPPORT

1.1 Instructor
Instructor: Petros Spachos, Ph.D.
Office: RICH 2505, ext. 54012
Email: petros@uoguelph.ca
Office hours: Wednesdays 6:00 pm– 7:00 pm or by appointment @ RICH 2505

1.2 Lab Technician
Lab Instructor: Kevin Dong
Office: RICH 2506, ext. 56455
Email: kdong@uoguelph.ca

1.3 Teaching Assistants

<table>
<thead>
<tr>
<th>GTA</th>
<th>Email</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colin Brennan</td>
<td><a href="mailto:cbrennan@mail.uoguelph.ca">cbrennan@mail.uoguelph.ca</a></td>
<td>TBA on CourseLink</td>
</tr>
<tr>
<td>Zhaohui Gu</td>
<td><a href="mailto:zgu04@uoguelph.ca">zgu04@uoguelph.ca</a></td>
<td></td>
</tr>
</tbody>
</table>

2 LEARNING RESOURCES

2.1 Course Website
Course material, news, announcements, and grades will be regularly posted to the ENGG*3640 CourseLink site. You are responsible for checking the sites regularly.
2.2 Required Resources

1. Lecture notes and slides

2.3 Recommended Resources

1. Radu Muresan, *ENGG3640 Microcomputer Interfacing Lecture Notes*, University of Guelph CourseLink, 2016 Version.

2.4 Additional Resources

**Lecture Information:** All the lecture notes are posted on the ENGG*3640* CourseLink system (week #1 to week #12) under the LECTURES module. Additional material is found under the COURSE MATERIAL module.

**Lab Information:** The handouts for all the lab sessions are within the lab section. All types of resources regarding tutorials, links to web pages can be found in this section.

**Assignments:** The assignments and the solutions for the assignments are posted on the ENGG*3640* CourseLink system under the ASSIGNMENTS module.

**Exams:** Some solutions of previous midterm exams will be posted on the ENGG*3640* CourseLink system under the EXAM SOLUTIONS section. Also, after the midterm exam a complete solution of the exam with the marking scheme applied will be posted for your reference.

**Miscellaneous Information:** Other information related to Microcomputer Interfacing topics will be posted on the web page.

2.5 Communication & Email

Please use lectures, tutorials and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** As per university regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its student.
3 ASSESSMENT

3.1 Dates and Distribution

Labs: 30% (Lab 1, 2 and 3 are 5% each; Lab 4 is 7% and 5 are 8%. Lab 6 is a bonus lab for 5%)
 See Section Error! Reference source not found. below for due dates

Midterm: 30%
 Tuesday, October 24th, 4:00 pm – 5:20 pm; TBA on CourseLink

Final Exam: 40%
 Wednesday, Dec. 6th, 7:00 pm - 9:00 pm, Room TBA on WebAdvisor

You must get ≥ 30% on the final exam, in order for the laboratory portion of the course to count
 towards the final grade, otherwise your final course grade will be at most 36.

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological,
or compassionate reasons, please email the course instructor. See the undergraduate calendar for
information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to
religious obligations, please email the course instructor at the start of the semester to make alternate
arrangements. See the undergraduate calendar for information on regulations and procedures for
Academic Accommodation of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade: In order to pass the course, you must pass both the laboratory and exam course portions.
Students must obtain a grade of 50% or higher on the exam portion of the course in order for the
laboratory write-up portion of the course to count towards the final grade.

Contesting marks: All laboratory, quizzes, and midterm exam marks must be contested within 2 day
from the grade submission. Also the exams must be written in pen or ink for contest considerations.

Missed midterm tests: If you miss a test due to grounds for granting academic consideration or religious
accommodation, you will need to arrange a makeup exam date with the instructor.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory demo due to grounds
for granting academic consideration or religious accommodation, arrangements must be made with
the teaching assistant to complete a makeup lab demo.

Late Lab Reports: Late submissions of lab reports will not be accepted. Lab reports are due the next day
of the lab, by 11:59 pm.
4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

This course focuses on the subject of interfacing microcomputers to external equipment. Topics include peripheral devices, hardware interfaces, device driver software and real time programming. Advanced programming such as: debugging of embedded systems, data structures and subroutine calls, high-level system programming. Interrupts and resets, real time events, signal generation and timing measurements. Synchronous and asynchronous serial communication. Parallel I/O ports and synchronization techniques. I/O interfacing, microcomputer busses, memory interfacing and direct memory access (DMA). Data acquisition topics include signal conditioning analog to digital conversion and digital signal processing.

Prerequisite(s): ENGG*2410, ENGG*2450; Restriction(s): ENGG*4640

4.2 Course Aims

This course is an introductory course in microcomputer interfacing and applications for students in computer engineering, electrical engineering, system and computing engineering and mechatronics engineering programs. The main goals of the course are: (1) to provide a broad and systematic introduction to microprocessors and microcontrollers, (2) to introduce the general processor ARM Cortex-M4 and complex microcontroller architectures using the Cortex –M4 processor (i.e., NXP Kinetis K family microcontroller architectures) and interfacing modules of typical microcontroller organizations, (3) present typical microcontroller interfaces, applications of these interfaces, and develop the theory around these applications and interfacing techniques.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Master microcontroller interfacing concepts and internal architecture
2. Understand electrical, electronics, digital and software concepts related to interface development and device functionality and control
3. Program interfaces in assembly language and C
4. Design with interfaces using interrupts, DMA, polling techniques
5. Design with human-machine interfaces and devices
6. Design with serial communication interfaces and devices.
7. Design with data acquisition interfaces and sensor devices.
8. Design with actuator control interfaces and devices.
9. Implement and demonstrate microcomputer interfacing applications (hardware and software).

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

<table>
<thead>
<tr>
<th>Graduate Attribute</th>
<th>Learning Objectives</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Knowledge Base for Engineering</td>
<td>1, 3, 4, 5, 6, 7, 8, 9</td>
<td>Exams, Labs</td>
</tr>
</tbody>
</table>
2. Problem Analysis 4 - 9 Exams, Labs
3. Investigation 9 Labs
4. Design 4-9 Exams, Labs
5. Use of Engineering Tools 2, 3 Exams, Labs
6. Communication 9 Labs
7. Individual and Teamwork 9 Labs
8. Professionalism - -
9. Impact of Engineering on Society and the Environment - -
10. Ethics and Equity - -
11. Environment, Society, Business, & Project Management - -
12. Life-Long Learning 1-9 Exams, Labs

4.5 Instructor’s Role and Responsibility to Students

The instructor’s role is to develop and deliver course material in ways that facilitate learning for a variety of students. All lecture notes plus various exercises, examples and referenced resources will be made available to students on CourseLink system in the appropriate module. However, these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide in class solutions to problems that supplement posted notes. Scheduled classes and labs will be the principal venue to provide information and feedback for tests and labs.

4.6 Students’ Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and labs. In addition students are encouraged to consult the instructor and the TA during the scheduled office hours or to contact the instructor or TA for any help needed. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

4.7 Relationships with other Courses & Labs

Previous Courses:


Follow-on Courses:

**ENGG*4420** (Real-Time Systems Design): Real-time concepts from a systems and computing perspective. Real-time operating systems for embedded designs. Real-time computer control and interfacing.

**ENGG*4560** (Embedded Systems Design): Systems-on-chip and embedded systems design. Embedded systems design tools.

## 5 Teaching and Learning Activities

### 5.1 Timetable

**Lectures:**

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday</td>
<td>4:00 pm – 5:20 pm</td>
<td>MACS 209</td>
</tr>
<tr>
<td>Thursday</td>
<td>4:00 pm – 5:20 pm</td>
<td>MACS 209</td>
</tr>
</tbody>
</table>

**Laboratory:**

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friday</td>
<td>Sec 01 1:30 pm – 4:20 am</td>
<td>RICH 1532</td>
</tr>
<tr>
<td>Thursday</td>
<td>Sec 02 8:30 am – 11:20 am</td>
<td>RICH 1532</td>
</tr>
</tbody>
</table>

### 5.2 Lecture Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics (Tentative*)</th>
<th>References</th>
<th>Learning Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, The Programmer’s Model, Instruction Set Description</td>
<td>Chapters 1-8</td>
<td>1, 2, 9</td>
</tr>
<tr>
<td>2</td>
<td>ARM Assembly Language Programming (I)</td>
<td>Chapters 2-8</td>
<td>2, 3, 9</td>
</tr>
<tr>
<td>3</td>
<td>ARM Assembly Language Programming (II)</td>
<td>Chapters 2-8, Chapter 13</td>
<td>2, 3, 9</td>
</tr>
<tr>
<td>4</td>
<td>Exception Handling</td>
<td>Chapters 14-17</td>
<td>1, 2, 4</td>
</tr>
<tr>
<td>5</td>
<td>Memory Mapped Peripherals</td>
<td>Chapter 16</td>
<td>1, 2, 9</td>
</tr>
<tr>
<td>6</td>
<td>Microcomputer Interfacing Principles (I)</td>
<td>Lecture Notes</td>
<td>1 – 4, 9</td>
</tr>
<tr>
<td>7</td>
<td>Microcomputer Interfacing Principles (II)</td>
<td>Lecture Notes</td>
<td>1 – 5, 9</td>
</tr>
<tr>
<td>8</td>
<td>Sensors, Data Acquisition,</td>
<td>Lecture Notes</td>
<td>1, 2, 3, 7, 9</td>
</tr>
<tr>
<td>9</td>
<td>Communication Interfaces</td>
<td>Lecture Notes</td>
<td>1, 2, 3, 6, 9</td>
</tr>
<tr>
<td>10</td>
<td>Actuators, FlexTimer Module</td>
<td>Lecture Notes</td>
<td>1, 2, 3, 8, 9</td>
</tr>
<tr>
<td>11</td>
<td>Human-Machine Interface</td>
<td>Lecture Notes</td>
<td>1 – 5, 9</td>
</tr>
<tr>
<td>12</td>
<td>Course review</td>
<td></td>
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</tr>
</tbody>
</table>

*Topics schedule will be adjusted throughout the course as needed.*
### 5.3 Lab Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 14 – 15</td>
<td>No lab</td>
<td></td>
</tr>
</tbody>
</table>
| September 21 – 22  | Laboratory 1 – Introduction  
MDK Tools, ARM Assembly – Timer Using  
Loop Delays  
Laboratory 1 - Demo  
Laboratory 2 – Introduction  
ARM Assembly – Simple Calculator  
Laboratory 2 - Demo  
Laboratory 3 – Introduction  
ARM Assembly – Interrupts  
Laboratory 3 - Demo  
Laboratory 4 – Introduction  
Interfacing K60 Microcontroller – GPIO,  
LEDs and 7–Segment Interfacing  
Laboratory 4 - Demo  
Laboratory 5 – Introduction  
Interfacing K60 Microcontroller – Timers,  
ADC and DAC Interfacing  
Laboratory 5 - Demo  
Laboratory 6 – Introduction  
Interfacing K60 Microcontroller – Motor Control, PWM  
Laboratory 6 - Demo | Lab manual | Lab manual (5%) | Lab manual (5%) | Lab manual (5%) | Lab manual (5%) | Lab manual (5%) | Lab manual (5%) | Lab manual (5%) |
| November 2 – 3     | Laboratory 5 – Open lab                                                 |                  |
| November 9 – 10    | Laboratory 5 – Open lab                                                 |                  |
| November 16 – 17   | Laboratory 6 – Open lab                                                 |                  |
| November 23 – 24   | Laboratory 6 – Open lab                                                 |                  |
5.4 Other Important Dates

- Thursday, September 7th, 2017: First day of classes
- Monday, October 9th, 2017: Thanksgiving holiday
- Tuesday, October 10th, 2017: Fall study day, no classes
- Friday, November 3rd, 2017: 40th class day, last day to drop classes
- Friday, November 29th, 2017: last day of classes

6 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

If the laboratory rules are not followed, consequences will include removing student’s access to the lab. If this, results in lab work not being completed the student will receive a grade of 0.

7 Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University’s policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at: http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.
The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

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8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.csd.uoguelph.ca/csd/

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9 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

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10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph’s procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index