ENG PHYS 3BB3
Electronics II, Embedding and Programming a Micro-Controller
Winter 2025
Course Outline

CALENDAR/COURSE DESCRIPTION

Design and synthesis project in electronics, based on the material presented in ENGPHYS 3BA3. Hands-on experience with microcontrollers and their programming will result in an 'intelligent product', in particular a PID-controlled process.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): ENGPHYS 3BA3, 3BA4 or PHYSICS 3BA3
Antirequisite(s): PHYSICS 3B06, 3BB3

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Mini Thomas	**Office Hours:**	**Lab Instructor**
thomam21@mcmaster.ca	By appointment	**Mohammadreza Shahzadeh**
		BSB B102/A
		shahzm14@mcmaster.ca

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

NATALE, Christopher	**KUMAR, Apurvata**	**DAYES, Brynmor**	**SOMENO, Dawit**
natalc@mcmaster.ca	kumara14@mcmaster.ca	dayesb@mcmaster.ca	somenod@mcmaster.ca

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COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://avenue.mcmaster.ca/, (Lectures in HH 305 and Labs in BSB B101 as per the schedule)

COURSE OBJECTIVES

Upon successful completion of the course, a student will:
1. Be able to program a microcontroller and interface it with analog electronic components.
2. Have followed a design process and created a device in which analog electronics is driven by a microcontroller.
3. Have designed and built a process under PID control.
4. Have worked in a small team.
5. Have communicated his/her work in written form.
6. Have presented his/her work to the class and the instructors.

MATERIALS AND FEES

Required Texts:
- There are no required texts for the microcontroller. It is recommended to read the various guides and data sheets that are provided on ATL;
- For engineering ethics read: https://www.ontario.ca/laws/regulation/900941#BK93 .

Other Materials:
- The Texas Instruments MSP430 LaunchPad development kit, and CP2102 USB to UART bridge need to be purchased. Instructions on how to obtain these will be posted on Avenue to Learn.
- Software to be download ahead of time: Texas Instruments' Code Composer Studio IDE. Further instructions will be posted on Avenue to Learn.
- For labs focused on C programming, Visual Studio Code for C programming needs to be installed ahead of time. Again, instructions will be posted on Avenue to Learn.
- A Student version of National Instrument's MultiSim, version higher than 10.0. (available from https://www.studica.ca/en/); should be used for the analog component of the design project.
- Other lab equipment (such as power supplies and oscilloscopes) and consumables (such as resistors, capacitors, and jumper wires) will be provided in the lab.

COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:
- Two, 1-hour classroom-based lectures per week (HH 305)
- Seven, exercise labs (one week each three hours, in BSB B101)
- One, four-week project (in BSB B101)

COURSE SCHEDULE

Lectures:

Date/Week	Topic	Readings
Week 1	Basics of C Programming	Lecture notes
Week 2	Introduction to Microcontrollers	Lecture notes
Week 3	Timer Module	Lecture notes
Week 4	Serial Communication	Lecture notes
Week 5	Interrupts	Lecture notes
Week 6	ADC	Lecture notes
Week 7	Reading Week	
Week 8	Serial Interface	Lecture notes
Week 9	Introduction to PID	Lecture notes
Week 10	Theory and Examples of PID	Lecture notes
Week 11-12	Project Review and Progress	

Labs:

Date	Topic	Readings
Week 1	Programming with C	Lab manual
Week 2	Introduction to Microcontrollers (LEDs on and off)	Lab manual
Week 3	Timer module	Lab manual
Week 4	Serial Communication	Lab manual
Week 5	Interrupts	Lab manual
Week 6	ADC	Lab manual
Week 7	Reading Week	
Week 8	Project Prep	Lab manual
Week 9	Project-Week 1	
Week 10	Project-Week 2	
Week 11	Project-Week 3	
Week 12	Project-Week 4	
Week 13	Project Demonstration	

ASSESSMENT

Component	Weight (%)	Comment
Pre- Lab Quiz	10	Submission due before respective labs
Lab exercises	35	Evaluated by presence, logbook submission, and in-person evaluation
Lab 6 short report	10	
Performance of final project	25	Demo to TA and instructor
Report on final project	20	
Total	100%	

ADDITIONAL DETAILS REGARDING COURSE MANAGEMENT AND ASSESSMENT

The 3BB3 course will be delivered with the following expectations from the students:

1. The emphasis is on success in the lab experiments and participation.
2. You will be expected to attend all lectures. The lectures will be on campus (HH305), and your presence will be recorded.
3. You will be expected to attend all labs you are registered for. The labs will be on campus (BSB B101). The TAs will help and check your attendance.
4. Unless stated otherwise, all lab reports and logbook activities are marked individually. The logbooks are marked by the TA at the end of the lab. The TAs will review your performance in the lab on the basis of the code and the log book submitted to ATL.
5. Students may makeup a **missed or incomplete lab within a maximum of two weeks** following the original lab session. After this period any missed lab will be assigned a grade of Zero.
6. The determination of the lab group size is at the discretion of the instructor.
7. You will write a short report (individual report) on lab 6.
8. The last 4 weeks will be dedicated to a PID project.
9. Each student is required to, individually, write a project report on the final project. As in 3BA3, you will submit a progress summary after each week, with the final submission being the complete report.
10. All work is to be submitted through ATL. All work must be prepared with a word processor; scanned or photographed. Hand-written work is not accepted (except for the log-book).

Your final report should be like the one from 3BA3, but it will include a description of the software solution that you chose. This should include the following:

1. Describe your solution. Include pseudo code, a flowchart, and a block diagram to aid in your description.
2. Pseudo code
    i. Write your algorithm for solving the problem
    ii. Pseudo code should not contain any actual code
    iii. Sample pseudocode guide: http://users.csc.calpoly.edu/~jdalbey/SWE/pdl_std.html
3. Flowchart
    i. Draw a flowchart to visually present your algorithm
    ii. Use any reasonable software to complete this
    iii. Sample guide: https://en.wikipedia.org/wiki/Flowchart
4. Block diagram
    i. Sketch out your solution (the circuit including the microcontroller), replacing sections with blocks and individually explaining the blocks, if necessary
    ii. Simple description: http://www.hobbyprojects.com/block_diagrams/block_diagrams.html

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ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for accreditation purposes only, and will not be taken into consideration in determining a student's actual grade in the course.

Outcomes	Indicators
Recognizes and follows an engineering design process.(This means an iterative activity that might include recognizing the goal, specifying the constraints and desired outcomes, proposing solutions, evaluating alternatives, deciding on a solution, and implementing.)	4.1
Recognizes and follows engineering design principles including appropriate consideration of environmental, social and economic aspects as well as health and safety issues.	4.2
Proposes solutions to open-ended problems.	4.3
Manages time and processes effectively, prioritizing competing demands to achieve personal and team goals and objectives.	6.1

For more information on Accreditation, please visit: https://www.engineerscanada.ca

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Engineering Physics is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the Equity and Inclusion Office.

PHYSICAL AND MENTAL HEALTH

For a list of McMaster University's resources, please refer to the Student Wellness Centre.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty:
1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

1. It is the students' responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.
2. Submission of an MSAF gives an automatic extension of **3 working days** for reports and assignments. The extension counts **from the original due date, NOT from the day of the MSAF submission**.
3. Late submission of the short lab report (lab 6) incurs a penalty of 10% per day.
4. Late submission of final project demo incurs a penalty of 20% per day.
5. Late submission of the final lab report incurs a penalty of 25% per day.

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. **Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:**

   • Use the McMaster Student Absence Form (MSAF) on-line self-reporting tool. No further documentation is required.
   • Students may submit requests for relief using the MSAF once per term.
   • An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
   • The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
   • The MSAF cannot be used for academic work that has already been completed attempted.
   • An MSAF applies only to work that is due **within the period for which the MSAF applies, i.e. the 3-day period** that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
   • The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. **For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:**

   • Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
   • If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office *normally within 10 working days* of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.