

**ENGPYHS 2E04**  
**Analog and Digital Circuits**  
**Undergraduate Studies**  
**Fall/Winter 2020/21**  
**Course Outline**

Current as of Tue 2020-09-01 06:58:22; see the course Forum for the most up-to-date version of this document

**CALENDAR/COURSE DESCRIPTION**

Design and analysis of analog and digital electrical circuits - component analysis, circuit analysis and theorems, binary numbers, Boolean analysis and digital circuit design.  
Three lectures, one lab (three hours each); second term

**PRE-REQUISITES AND ANTI-REQUISITES**

Prerequisite(s): PHYSICS 1E03 and registration in an Engineering program  
Antirequisite(s): None

**INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION**

Dr. Matt Minnick  
BSB/B106  
[minnick@mcmaster.ca](mailto:minnick@mcmaster.ca)  
ext. 24546

Office Hours:  
All the time asynchronously via the course forum  
Live via course forum during class time  
Use the forum! :-)

**LAB TECHNICIAN**

Peter Jonasson  
[jonasso@mcmaster.ca](mailto:jonasso@mcmaster.ca)  
BSB/B102  
Ext. 22657

**TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION**

TBA

**COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION**

Course Forum: Microsoft Teams

**COURSE INTENDED LEARNING OUTCOMES**

Upon successful completion of the course, you will be able to:

1. Analyze analog and digital electrical circuits;
2. Simulate analog and digital circuits using software-based tools;
3. Design, implement and test analog and digital electrical circuits using simulation software and laboratory measurement equipment.
4. Perform circuit measurements taking into account the specifications of electrical measuring equipment.

**MATERIALS AND FEES**

#### COMPUTER:

Students should have a laptop or Desktop capable of simultaneously running an equation solver (e.g., Maple, MATLAB, Python, etc.), a circuit solver (e.g., MultiSim, SPICE, etc.) and Microsoft Word (Windows machines are recommended, price point of \$300 or up should be fine). You are required to use this for the labs.

#### SOFTWARE:

MS Word (2007 or newer) & MS Teams (current version)  
NI Multisim simulation software (ideally version 14 or newer)  
Maple (Version 15 or higher)

#### HARDWARE

1. Level 2 Hantek channel digital storage component kit vistatech. This includes a Hantek 3in1 scope bundled with extra probes, a breadboard, and a large number of analog and digital components. This is mandatory for ENGPYHS 2A04, 2E04, 3BA4, 3BB4, and 3L04, and potentially a big help (if not mandatory) in ENGPYHS 4A06, and 4US2, among other courses. However, you only need to buy it once, then buy specific circuit supplements for following courses.

2. ENGPYHS 2E04 circuit component supplement. This includes all the components you need (along with the Hantek kit) to complete the course deliverables.

#### TEXTBOOKS:

- Principles and Applications of Electrical Engineering, 6th edition, Giorgio Rizzoni, McGraw Hill
- Course Notes (free online)
- Sample Problems (free online)
- Course Videos (free online)

### COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:

Resources:

- Lecture notes & examples (online)
- Worked Example Practice Problems (online)
- Course videos explaining the notes & some practice problems each week (online)
- The forum, where you can get help from me, the TAs, and each other

The course is divided into two parts, analog and digital. The analog section has 5 content weeks followed by a mini-design project, while the digital part has 4 content weeks followed by a major design project. The content week deliverables are **prep work** (work that is primarily for you to learn the material for your own benefit) while the project weeks are **portfolio work** (work that is something you'd keep to show off to a potential employer). [See the Course Schedule](#) in the next section.

Your deliverable for regular content weeks and the mini-design project is as follows:

Work through all the topic's course notes, practice problems, and videos. While working through the problems, where possible try to "**Tri-Solve**" them (solve them analytically, simulate them with multisim, and build and measure them).

Then finally: create a variation of the sample lab circuit for that week which emphasizes the topics and is a challenge for you and Tri-Solve it; Analytically solve it, simulate it with multisim, and build and measure it. Submit a writeup of the circuit explaining how it works and your analytical solution method, showing your multisim solution results (include any code as supplementary files), and show images of your working circuit detailing output from your Hantek device. Comment on any discrepancies between the three results.

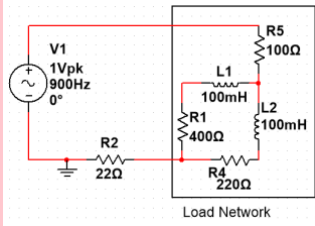

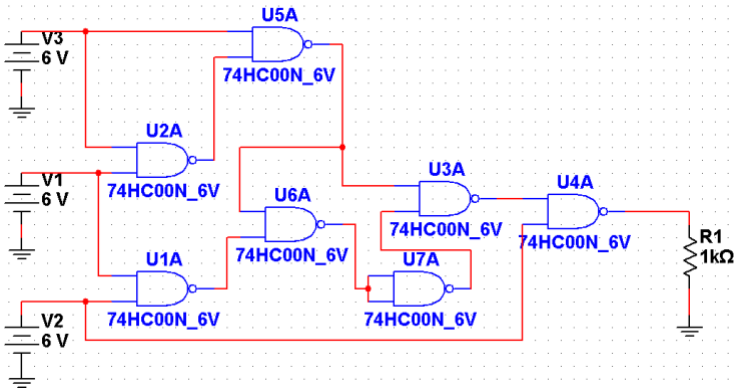
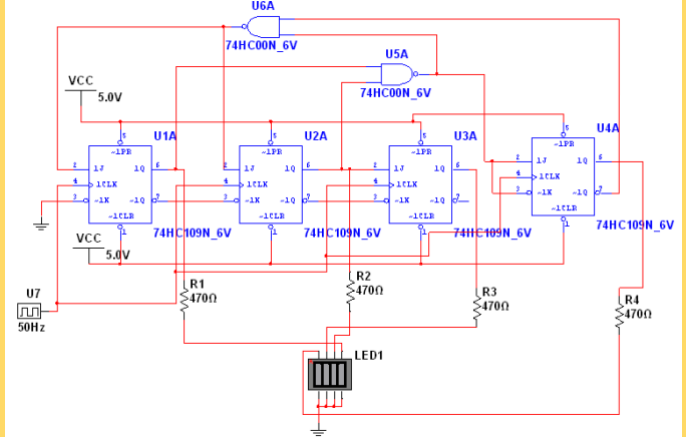
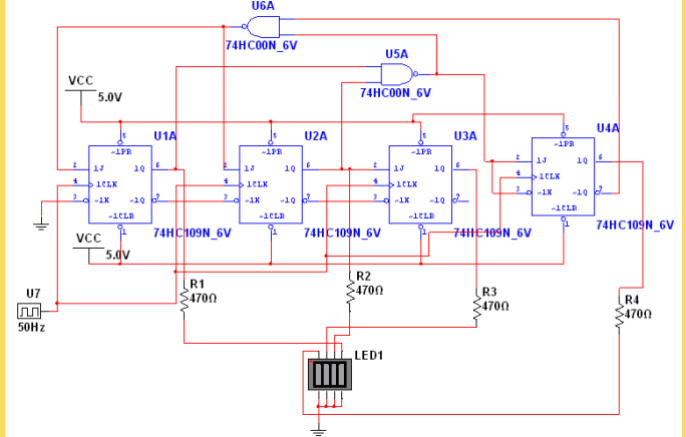
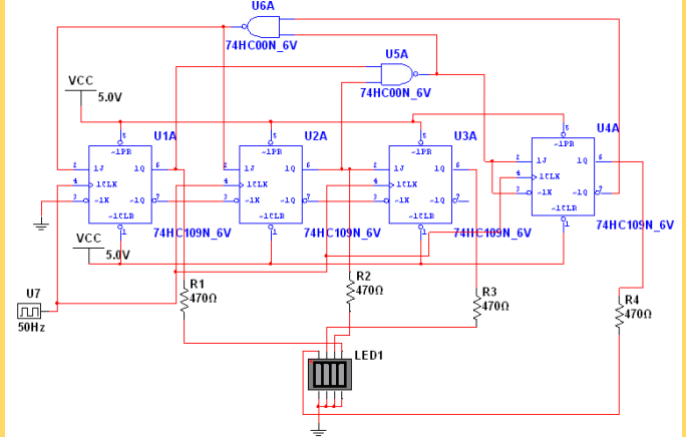
The analog design project is a synthesis project or challenge extension of a topic covering all of the analog topics of the course. Choose one or two you found challenging, possibly combining them, and create and Tri-Solve a challenging new problem.

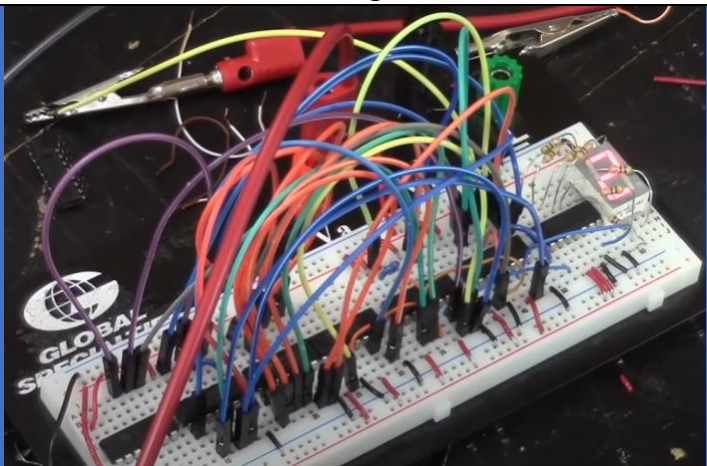
The final design project is a large digital design exercise: *use sequential logic design and a decoder chip to make a 7SD cycle through your student number.* This will be more fully explained in a supplementary file online.

(all deliverables are due by 23:59 EST on the final Friday of their week specified in the schedule; the final design project is due on Friday April 9th only; nothing is due on Friday April 2nd)

**COURSE SCHEDULE**

| Date       | Topic                               | Image |
|------------|-------------------------------------|-------|
| Wed Jan 06 | 1. DC Resistive Network Analysis    |       |
| Thu Jan 07 |                                     |       |
| Mon Jan 11 |                                     |       |
| Wed Jan 13 |                                     |       |
| Thu Jan 14 | 2. AC Steady-State Network Analysis |       |
| Mon Jan 18 |                                     |       |
| Wed Jan 20 |                                     |       |
| Thu Jan 21 | 3. Transient Analysis               |       |
| Mon Jan 25 |                                     |       |
| Wed Jan 27 |                                     |       |
| Thu Jan 28 | 4. Frequency Response & Filters     |       |
| Mon Feb 01 |                                     |       |
| Wed Feb 03 |                                     |       |
| Thu Feb 04 |                                     |       |

| Date       | Topic  | Image  |
|------------|--|--|
| Mon Feb 08 | 5. AC Power                                      |    |
| Wed Feb 10 |  |  |
| Thu Feb 11 |  |  |
| Mon Feb 15 | Reading Week                                     |  |
| Wed Feb 17 |  |  |
| Thu Feb 18 |  |  |
| Mon Feb 22 | Design Project 1:<br>Analog Synthesis<br>Project |    |
| Wed Feb 24 |  |  |
| Thu Feb 25 |  |  |
| Mon Mar 01 | 6. Digital Logic<br>Analysis                     |   |
| Wed Mar 03 |  |  |
| Thu Mar 04 |  |  |
| Mon Mar 08 | 7. Digital Logic Design                          |  |
| Wed Mar 10 |  |  |
| Thu Mar 11 |  |  |
| Mon Mar 15 | 8. Sequential Digital<br>Logic Analysis          |  |
| Wed Mar 17 |  |  |
| Thu Mar 18 |  |  |
| Mon Mar 22 | 9. Sequential Digital<br>Logic Design            |  |
| Wed Mar 24 |  |  |
| Thu Mar 25 |  |  |

| Date       | Topic  | Image  |
|------------|--|--|
| Mon Mar 29 | Design Project 2:<br>Sequential Logic Design |  |
| Wed Mar 31 |  |  |
| Thu Apr 01 |  |  |
| Mon Apr 05 | Design Project 2:<br>Sequential Logic Design |  |
| Wed Apr 07 |  |  |
| Thu Apr 08 |  |  |

**ASSESSMENT**

| Component                 | Weight            |
|---------------------------|-------------------|
| Content Week Deliverables | 63% (7% each * 9) |
| Self-Reflection Surveys   | 3% (1% each * 3)  |
| Design Project 1          | 12%               |
| Design Project 2          | 22%               |
| <b>Total</b>              | <b>100%</b>       |

**ACCREDITATION LEARNING OUTCOMES**

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

| Outcomes  | Indicators   |
|---|--|
| <b>By learning techniques involved in Tri-Solving circuit problems, understands limits of physical measures, analytical work, and simulations</b> | 02.3 - Obtains substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions. |
| <b>Uses appropriate analytical tools, simulation software, and measurement tools</b>  | 03.2 - Selects appropriate model and methods and identifies assumptions and constraints.   |
| <b>Generates appropriate circuit extensions and solutions in design projects</b>  | 04.3 - Proposes solutions to open-ended problems.  |

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](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), 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.

#### 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](mailto: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

It is the students’ responsibility to regularly check the course forum for updates and announcements. Under normal circumstances, missed deadlines correspond to a reduction in grade as per the assessment section.

#### 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.
    - a. Relief in this course means an extension on the due date of the deliverable(s) by 3 calendar days.
  - 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 or 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.