

ENGPYHS 3BA3
Electronics I: Circuits with Non-Linear and Active Components
Fall 2023
Course Outline

CALENDAR/COURSE DESCRIPTION

This course provides the theory as well as the practical introduction to semiconductor electronics including P-N junctions, diodes, bipolar junction transistors, field effect transistors, DC and AC modeling, differential and operational amplifiers, feedback and oscillators, digital circuits and multivibrators, signal processing.

In this course, students will learn how to build a computer, starting from sand.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): One of ENG PHYS 2A03, 2A04, 2E04, MEDPHYS 2B03, PHYSICS 2B06, 2BB3
Antirequisite(s): PHYSICS 3B06, PHYSICS 3BA3

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Mini Thomas

thomam21@mcmaster.ca

Office Hours:

By appointment

Instructional Assistant:

Mohammadreza (Reza) Shahzadeh

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TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Reza Fathi

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COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

<http://avenue.mcmaster.ca/> , email.

COURSE INTENDED LEARNING OUTCOMES

Upon successful completion of the course, a student will:

- Be able to explain the basic properties of semi-conductors that are relevant for modern electronic devices.
- Be able to analyse electronic circuits with active components, both theoretically and experimentally.
- Be able to create electronic circuits with analog and digital components according to high-level requirements.

- Have communicated his/her work in written form.

MATERIALS AND FEES

Lab Instruments and Components:

All necessary lab components will be provided by the instructional assistant and are mostly available in the lab.

Texts:

The textbook used in this course is "Electronics: A Physical Approach", David W. Snoke, Pearson Education Inc., 2015, ISBN 978-0-321-55133-7. This is the standard text; the references in this outline and in the lecture slides refer to this text.

Other reference material:

- "Principles and Applications of Electrical Engineering", Giorgio Rizzoni, 5th Edition, McGraw-Hill, 2007, ISBN 978-0-07-296298-7
- "Electronic Devices and Circuit Theory", Boylestad, R. L. and Nashelsky L., any edition.

Calculator:

- Only the McMaster Standard Calculator would be permitted in tests and examinations which this course does not have. This calculator is available at the Campus Store.

Other Materials:

National Instrument's MultiSim, version higher than 10.0. (current version is 14.3)

- Available from <http://www.studica.com> ;
- Online version available at <http://www.multisim.com>

COURSE FORMAT AND EXPECTATIONS

- The course will be delivered in two lectures per week.
- The labs are scheduled on Wed-Fri afternoons, every week.
- Students are required to attend the labs.

ASSESSMENT

The assessment is based on the following items, all marked by TAs (except pre-lecture quizzes).

1. Pre-lecture quizzes
2. Assignments.
3. Lab exercises, based on the lab book and Multisim submission. The lab book will be evaluated at the end of the lab; the Multisim simulation (if needed) should be prepared ahead of the lab and submitted to ATL for the TA to mark at the beginning of the lab.
4. Reports for lab 3 (short) and the project (standard)
5. Project demo.

Component	Weight (%)
Pre-lecture quizzes	10
Assignments	20
Lab Exercises	30
Lab Report BJT	10
Lab Report Project	15
Project Performance (Demo)	15
Total	100%

COURSE SCHEDULE

Lectures and labs

Week	Lecture Topic/ Content	Reading (Smoke)	Labs	Reporting
1	Course Intro + Semi Basics	Ch. 4.1-4.4	Intro	N/A
2	Semi Basics Contd. + PN Junction Diodes (02)	Ch. 4.5		
2	Diode Applications + Lab 1 (explain)	Ch. 4.5	PN Junction, I-V Characteristics	Log book sign-off
3	BJT Intro	Ch. 4.1-4.4		
3	BJT CE Model + Lab 2 (explain)	Ch. 5.1-5.3	Diode Application	Log book sign-off
4	Bias Stability	Ch. 5.1-5.3		
4	Voltage Divider Bias + Lab 3 (explain)	Lec. Notes, Rizzoni 10.4	BJT Common Emitter Amplifier	Log book sign-off
5	Multistage Amplifiers & Frequency Response	Lec. Notes		Log book sign-off
5	Differential Amplifiers + Lab 3 (Continued)	Lec. Notes	BJT Common Emitter Amplifier (cont'd)	Report (short)
Thanksgiving (midterm recess)				
6	Op-amps	Ch. 6.1-6.2		
6	Op-amps (LM741) + Lab 4 (explain)	Ch. 6.3, 6.4	Op Amps	Log book sign-off
7	Multivibrators + LM 555	Lec. Notes		
7	Boolean Algebra, Digital logic circuits, clocked digital logic circuits + Lab 5 (explain)	Ch. 7.1-7.6	Digital counter	Weekly report
8	Clocked digital logic circuits, timing diagrams (Contd.)	Ch. 7.3-7.6		Weekly report
8	Oscillators + Lab 6 (explain)	Ch. 6.5	Project	

Week	Lecture Topic/ Content	Reading (Snoke)	Labs	Reporting
9	JFETS	Ch. 5.4.1	Start design project	
9	JFETS + Lab 6 (update)	Ch. 5.4.4		
10	MOSFETs	Ch. 5.4.2	Design project plan	Discuss with TA's
10	MOSFETs + Lab 6 (update)	Ch. 5.4.2		Weekly report
11	Memory Cell	Lec. Notes		Weekly report
11	Arithmetic-Logic Unit + Lab 6 (update)	Lec. Notes		Weekly report
12	Microprocessor/microcontroller lay-out (Microprocessor folder)	Lec. Notes	Design project presentation	Demo
12	Assembly language (Microprocessor folder)	Lec. Notes		
13	Recap			

* Please note the weeks are subject to change due to unavoidable circumstances or weather conditions.

ADDITIONAL DETAILS REGARDING COURSE MANAGEMENT AND ASSESSMENT

1. Class attendance is not mandatory but encouraged. There is a clear correlation between class attendance and performance in the course;
2. Attendance at the weekly lab sessions is mandatory;
3. Labs are performed in groups of two.
4. Unless stated otherwise, lab reports and logbooks are marked individually. The logbooks are marked by the TA at the end of the lab.
5. All work (except logbooks) is to be submitted through ATL.
6. Multisim simulations necessary for the lab should be prepared ahead of time and submitted to ATL for the TAs to mark at the beginning of the lab.
7. Reports and assignments must be prepared with a word processor; scanned or photographed; hand-written work is not accepted. However, diagrams and/or drawings may be hand-drawn (neatly) and pasted into the report.

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for no good reason and will not be directly taken into consideration in determining a student's actual grade in the course.

<u>Outcomes</u>	<u>Indicator</u> <u>s</u>
Selects appropriate model and methods and identifies assumptions and constraints.	03.2
Develops and implements processes and methodologies to manage the effectiveness of a team both in terms of the quality of the work produced by the team as well as the inter-personal relationships within the team.	06.2
Presents instructions and information clearly and concisely as appropriate to the audience	07.2

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. Submission of an msaf gives an automatic extension of 5 days for reports and assignments. The extension counts from the original due date, NOT from the day of the msaf submission.
2. Submission of an msaf for a pre-lecture quiz gives an exemption for that quiz, i.e. its weight is reweighted to the other quizzes.
3. Late submissions of reports and assignments incur a penalty of 10% 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.