ENGINEERING
McMaster-Mohawk
Bachelor of Technology
Partnership

McMaster University

# Course Outline

## 1. COURSE INFORMATION

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| **Session Offered** | Fall 2021 | |
| **Course Name** | Electricity & Electronics 2 | |
| **Course Code** | Proc Tech 2EE3 | |
| **Date(s) and Time(s) of lectures** | Lecture: Tue 12:30 – 2:20<br>Tutorials: Thu 1:30 – 3:20 (T01); 3:30 – 5:20 (T02) | |
| **Program Name** | Process Automation Technology | |
| **Calendar Description** | Second course in electricity and electronics covers transformers, passive and active filters, and semiconductor diodes and transistors theory and applications. | |
| **Instructor(s)** | Lectures:<br>Yaser M. Haddara<br><br>Labs:<br>Mehdi Alimardani<br>Hassanain Awadh<br><br>TA information will be posted on Avenue | <br>yaser@mcmaster.ca<br>Office Hours online TBA on Avenue<br><br><br>alimarm@mcmaster.ca<br>hawadh@mcmaster.ca |

## 2. COURSE SPECIFICS

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| **Course Description** | Second course in electricity and electronics covers transformers, passive and active filters, and semiconductor diodes and transistors theory and applications. | | |
| **Instruction Type** | **Code** | **Type** | **Hours per term** |
| | C | Classroom instruction | 26 |
| | L | Laboratory, workshop or fieldwork | 30 |
| | T | Tutorial | 24 |
| | DE | Distance education | |
| | | **Total Hours** | 80 |
| **Resources** | **ISBN** | **Textbook Title & Edition** | **Author & Publisher** |
| | 1. 978-0-13-392360-5<br><br>2. N/A | Introductory Circuit Analysis, 13th ed.<br><br>Semiconductor Devices: Theory & Application, version 1.0.1 | Robert Boylestad, Pearson.<br><br>James M. Fiore, Free pdf text will be available on Avenue |
| | **Other Supplies** | **Source** | |
| | 1. Analog Discovery 2<br>2. 2EE3 lab kit | Bookstore | |

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| | 3. 1EL3 lab kit if you don't already have it | |
| **Prerequisite(s)** | Eng Tech 1EL3, 1MC3 and registration in level II or above of Automation Engineering Technology. | |
| **Corequisite(s)** | None | |
| **Antirequisite(s)** | None | |
| **Course Specific Policies** | • Exams are comprehensive<br>• All tests are closed book with a formula sheet provided by the instructor<br>• **The instructor reserves the right to choose the format of any deferred midterms or final exams (format may be written or oral)**<br>• Communication from the instructor to all students will be either posted on Avenue as an update or emailed from Mosaic to the class list; students need to update their email address on Mosaic and to check emails regularly. In particular, this will be the way that I will communicate any emergency class cancelation or reschedule.<br>• Communication to the instructor **must** be directed to the **yaser@mcmaster.ca** email address and **must** contain the tag [2EE3] in the subject line. Emails sent to my Avenue inbox or not containing the appropriate tag in the subject line may be ignored.<br><br>Please note that announcements concerning any type of graded material may be in any format (e.g. announcements may be made only in class). In particular, any announcement made in class, posted on Avenue, or emailed via Mosaic is considered delivered and students are responsible for the material or assessment announced. What this means is that if you skip class and an announcement for a quiz, lab, test, etc. is made in that class, then you are still responsible for that material. If you miss it, then you get a zero.<br><br>Lab reports required may be in any format including a written report, an avenue quiz, submission of the lab record sheet, or a video presentation. | |
| **Departmental Policies** | Students must maintain a GPA of 3.5/12 to continue in the program.<br><br>In order to achieve the required learning objectives, on average, B.Tech. students can expect to do at least 3 hours of "out-of-class" work for every scheduled hour in class. "Out-of-class" work includes reading, research, assignments and preparation for tests and examinations.<br><br>Where group work is indicated in the course outline, such collaborative work is mandatory.<br><br>The use of cell phones, iPods, laptops and other personal electronic devices are prohibited from the classroom during the class time, unless the instructor makes an explicit exception.<br><br>Announcements made in class or placed on Avenue are considered to have been communicated to all students including those individuals that are not in class. | |

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| | Instructor has the right to submit work to software to identify plagiarism. |
| **3. SUB TOPIC(S)** | |
| Week 1 | **CHAPTERS 13-20**<br>REVIEW of AC Circuit Analysis |
| Week 2 | **CHAPTER 22**<br>**FILTERS AND THE BODE PLOT**<br>22.1 Introduction<br>22.2 Properties of Logarithms<br>22.3 Decibels<br>22.4 Filters<br>22.5 RC Low-Pass Filters |
| Week 3 | 22.6 RC High-Pass Filters<br>22.7 Bandpass Filters<br>22.11 Bode Plots<br>22.12 Sketching the Bode Response<br>22.15 Additional Properties of Bode Plots<br>22.17 Applications |
| Week 4 | **Semiconductor Devices and Circuits Section**<br>**Textbook: Semiconductor Devices by James Fiore**<br>**Free textbook – Posted on Avenue**<br><br>**IC OPERATIONAL AMPLIFIERS AND BASIC OP-AMP CIRCUITS**<br>14.1 Integrated Circuit Operational Amplifiers<br>14.2 Biasing Operational Amplifiers<br>14.3 Voltage Follower Circuits<br>14.4 Non-Inverting Amplifiers<br>14.5 Inverting Amplifiers |
| Week 5 | **BASIC SEMICONDUCTOR AND PN-JUNCTION THEORY**<br>1.1 Atomic Theory<br>1.2 Conduction in Solids<br>1.3 Conductors, Semiconductors, and Insulators<br>1.4 n-Type and p-Type Semiconductors<br>1.5 The pn-Junction<br>1.6 Biased Junctions |
| Midterm Recess: Monday, October 11 to Sunday, October 17 | |
| Week 6 | **SEMICONDUCTOR DIODES**<br>2.1 pn-Junction Diodes<br>2.2 Characteristics and Parameters<br>2.3 Diode Approximations<br>2.4 DC Load Line Analysis<br>2.9 Zener Diodes<br><br>**TERM TEST 1** |
| Week 7 | **DIODE APPLICATIONS**<br>3.1 Half-Wave Rectification<br>3.2 Full-Wave Rectification<br>3.4 Full-Wave Rectifier Power Supply<br>3.6 Power Supply Performance and Testing<br>3.7 Zener Diode Voltage Regulators |

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| Week 8 | **BIPOLAR JUNCTION TRANSISTORS (BJTs)**<br>4.1 BJT Operation<br>4.2 BJT Voltages and Currents<br>4.3 BJT Amplification<br>4.4 BJT Switching<br>4.6 Common-Emitter Characteristics<br><br>**BJT BIASING**<br>5.1 DC Load Line and Bias Point<br>5.2 Base Bias<br>5.4 Voltage-Divider Bias<br>5.5 Comparison of Basic Bias Circuits<br>5.6 Troubleshooting BJT Bias Circuits<br>5.7 Bias Circuit Design |
| Week 9 | **AC ANALYSIS OF BJT CIRCUITS**<br>6.1 Coupling and Bypassing Capacitors<br>6.3 Transistor Models and Parameters<br>6.4 Common-Emitter Circuit Analysis<br>6.6 Common-Collector Circuit Analysis<br>6.8 Comparison of CE, CC, and CB Circuits |
| Week 10 | **FIELD EFFECT TRANSISTORS**<br>9.1 Junction Field Effect Transistors<br>9.2 JFET Characteristics<br>9.3 JFET Data Sheets and Characteristics<br>9.4 JFET Amplification and Switching 9.5 MOSFETs<br><br>**FET BIASING**<br>10.1 DC Load Line and Bias Point<br>10.4 Voltage-Divider Bias<br>10.10 MOSFET Biasing<br><br>**TERM TEST 2** |
| Week 11 | **AC ANALYSIS OF FET CIRCUITS**<br>11.2 FET Models and Parameters<br>11.3 Common-Source Circuit Analysis<br>11.7 Comparison of FET and BJT Circuits |
| Week 12 | **CHAPTER 23 (Boylestad textbook)**<br>**TRANSFORMERS**<br>23.1 Introduction<br>23.3 The Iron-Core Transformer<br>23.4 Reflected Impedance and Power<br>23.5 Impedance Matching, Isolation, and Displacement<br>23.6 Equivalent Circuit |
| Week 13 | **REVIEW** |
| Classes end: Wednesday, December 8<br>Final examination period: Thursday, December 9 to Wednesday, December 22<br>All examinations MUST be written during the scheduled examination period. | |
| **List of experiments: Labs begin in Week 2 (September 15-16)** | |
| Lab 0 | Using Analog Discovery 2 |
| Lab 1 | Resonance |

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| Lab 2 | Low pass and high pass filters |
| Lab 3 | Bandpass filters |
| Lab 4 | Op-amps |
| Lab 5 | Active filters |
| Lab 6 | Diodes |
| Lab 7 | BJTs |
| Lab 8 | FETs |
| Lab 9 | Transistor amplifiers |

Note that this structure represents a plan and is subject to adjustment term by term.
The instructor and the University reserve the right to modify elements of the course during the term. The University may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes.

| **4. ASSESSMENT OF LEARNING *including dates*** | **Weight** |
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| Weekly quizzes | 5 |
| Mid-term tests | 30 |
| Class participation | 5 |
| Labs | 30 |
| Final examination (tests cumulative knowledge) | 30 |
| **TOTAL** | **100%** |

Percentage grades will be converted to letter grades and grade points per the University calendar.

## 5. LEARNING OUTCOMES

1. Classify filter circuits according to their frequency response
2. Explain operation of transformer circuits and their performance parameters
3. Explain principles of operation of semiconductor devices
4. Compare characteristics and specifications of diodes, transistors, and amplifiers
5. Design filter circuits, transformer circuits, power supply regulation circuits, and transistor amplifier circuits to meet specifications and design constraints
6. Check the performance of microelectronic circuits against real world application requirements

## 6. COURSE OUTLINE – APPROVED ADVISORY STATEMENTS

### ANTI-DISCRIMINATION

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.
http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&Response.pdf

### 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: The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- 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

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.

## ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

## COMMUNICATIONS

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their @mcmaster.ca alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.
- Check the McMaster/Avenue email and course websites on a regular basis during the term.

## 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.

## REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): 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".

## 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. http://www.mcmaster.ca/policy/Students-AcademicStudies/Studentcode.pdf

## 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.