

EP3PN4
Semiconductor Devices
 Winter 2018
 Course Outline

CALENDAR/COURSE DESCRIPTION

This course provides fundamental in-depth knowledge of the physical principles and operational characteristics of semiconductor devices. The major emphasis is on a review of band theory, and an introduction to non-equilibrium charge carriers, junction diodes, bipolar junction transistors (BJT) and related devices such as photodiodes, LEDs and solar cells. The physics and some applications of various versions of these devices will be considered. This course also lays a necessary foundation for field effect transistors and specialized devices treated in the Engineering Physics 4F03 course. There will be graded assignments, one term test, 4 laboratory experiments, and a final examination.

LECTURES:

Monday 9:30am
 Tuesday 10:30am
 Thursday 9:30am
 JHE210

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): ENG PHYS 3F03 or MATLS 3Q03, or credit or registration in ENGPYS 3F03

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Adrian Kitai
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Office Hours:

By appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

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Office Hours:

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

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

COURSE OBJECTIVES

By the end of this course, students should be able to understand the following on both a qualitative and quantitative basis:

- The physical principles and operational characteristics of semiconductor devices in the context of band theory
- Non-equilibrium charge carriers
- Junction diodes
- Photodiodes and basic solar cell concepts
- LEDs in detail
- Bipolar junction transistors (BJT)

MATERIALS

Required Texts:

- 1) Principles of Solar Cells, LEDs and Diodes: the role of the p-n junction, 2011, John Wiley, by Adrian Kitai
- 2) Other supplementary material to be made available at no cost

Supplementary References:

- 1) Semiconductor Microdevices and Materials, D.H. Navon
- 2) Fundamentals of Semiconductor Devices, E.S. Yang
- 3) Physics of Semiconductor Devices, S.M. Sze
- 4) Semiconductor and Electronic Devices, A. Bar-Lev
- 5) Lectures on the Electrical Properties of Materials, L. Solymar & D. Walsh

Calculator:

Any non-networked calculator is acceptable.

Other Materials:

COURSE OVERVIEW

See Course Objectives.

ASSESSMENT

This course may be taken in two modes. In **Mode A** attendance at lectures is expected. In **Mode B** attendance at lectures is optional. Mode B is available only upon request and all students will be automatically enrolled in Mode A. Mode B does not

constitute an ideal learning environment for most students. *Students who wish to leave Mode A must act before the 7th lecture. After this date, no transfers to Mode B will be permitted.*

Mode A

Component	Weight
Assignments	10%
Midterm	20%
Laboratories	15%
Class Participation	15%
Final Exam	40%
Total	100%

Class participation will be determined as follows:

- Two student representatives will be responsible for submitting a class participation grade to the instructor.
- The class participation grade will include a component connected to attendance which will be taken at each lecture. How attendance factors into the participation grade will be determined by the student representatives.
- A further component of the class participation grade will be determined by student performance as judged by the other students during homework problem presentations. At the beginning of each lecture a student will take up one homework problem for the first 10 minutes of each lecture. All students in Mode A will have a chance to present a homework problem.
- The TAs will be available to help students who are presenting homework solutions. TAs will also help with laboratories. TAs will be responsible for preparing complete homework solutions that will be made available to all students after questions are taken up in class.

Mode B

Component	Weight
Laboratories	15%
Midterm	25%
Final Exam	60%
Total	100%

- Classroom attendance is optional however attendance at as many lectures as possible is highly recommended.
- As with Mode A students, Mode B students must attend all laboratories in person, do the labs, and hand in satisfactory lab reports to be eligible to pass the course.

LABS:

Lab manuals will be available on Avenue to Learn. Every lab report must be done individually. ***All labs must be completed in person to pass the course: this includes attendance at the lab, satisfactory performance in the lab and a satisfactory report.***

ACCREDITATION LEARNING OUTCOMES

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

Outcomes	Indicators
<p>Knowledge Base for Engineering I will take a few suitable questions on final, ones that test the learning outcomes identified for the course, and as I'm grading keep track of how the students are doing in a rubric.</p>	<ul style="list-style-type: none"> • Ability to correctly interpret question • Ability to approach question correctly • Ability to obtain correct answers
<p>Engineering Design On selected problems the following rubric will be used to assess this based on selected questions on the exam.</p>	<ul style="list-style-type: none"> • Ability to correctly interpret problem • Ability to approach problem in a rational manner • Ability to obtain a credible design

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

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.

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.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <http://www.mcmaster.ca/academicintegrity>

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.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University's Policy for [Academic Accommodation of Students with Disabilities](#).

NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

1. The [McMaster Student Absence Form](#) is a self-reporting tool for Undergraduate Students to report absences DUE TO MINOR MEDICAL SITUATIONS that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note this tool cannot be used during any final examination period.
2. You may submit a maximum of 1 Academic Work Missed request per term. It is YOUR responsibility to follow up with your Instructor immediately (NORMALLY WITHIN TWO WORKING DAYS) regarding the nature of the accommodation. Relief for missed academic work is not guaranteed.
3. If you are absent for reasons other than medical reasons, for more than 3 days, or exceed 1 request per term you MUST visit the Associate Dean's Office (JHE/H301). You may be required to provide supporting documentation.
4. This form must be submitted during the period of absence or the following day, and is only valid for academic work missed during this period of absence.
5. It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in his/her course.
6. You should expect to have academic commitments Monday through Saturday but not on Sunday or statutory holidays. If you require an accommodation to meet a religious obligation or to celebrate an important religious holiday, you may submit the Academic Accommodation for Religious, Indigenous and Spiritual Observances (RISO) Form to the Associate Dean's Office. You can find all paperwork needed here: <https://www.eng.mcmaster.ca/programs/academic-advising>

NOTICE REGARDING POSSIBLE COURSE MODIFICATION

The instructor and 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. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

TURNITIN.COM STATEMENT

In this course we will be using a web-based service (Turnitin.com) to reveal plagiarism. Students will be expected to submit their work electronically to Turnitin.com and in hard copy so that it can be checked for academic dishonesty. Students who do not wish to submit their work to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to <http://www.mcmaster.ca/academicintegrity/>.

ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK

In this course, we will be using Avenue to Learn. Students should be aware that, when they access the electronic components of this course, 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 this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to

<http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf>.