



Course Outline

Instructor

- Prof. Douglas Buchanan, P.Eng.
E3-453 EITC
(204) 474-9085
Douglas.Buchanan@umanitoba.ca
- Prof. Douglas Thomson, P.Eng.
E3-455 EITC
(204) 474-8797
Douglas.Thomson@umanitoba.ca

Office Hours

- By appointment – please email.

Teaching Assistant

- Mayank Thacker
thacker5@myumanitoba.ca
- Zahra Taban
tabanz@myumanitoba.ca

Contact Hours

- 4 credit hours
- Lectures:
3 hours x 13 weeks = 39 hours
- Laboratories:
3 hours x 5 weeks = 15 hours

Prerequisites:

- ECE 3670 Electronics 3
- PHYS 2152 Modern Physics for Engineers
- MATH 3132 Engineering Mathematical Analysis 3

Course Website:

<http://umanitoba.ca/umlearn>

Important Dates

- **Term Test**
Tuesday, March 2nd, 2021
6:00PM – 8:00PM
- **Voluntary Withdrawal Deadline**
March 31st, 2021
- **Louis Riel Day**
February 15th, 2021
No classes or examinations
- **Spring Break**
February 16th – 19th, 2021
No classes or examinations
- **Good Friday**
April 2nd, 2021
No classes or examinations

ECE 3600 – Physical Electronics

Winter 2021

IMPORTANT NOTICE – Mandatory Requirement to Report

This course will be conducted using remote instruction. Students who are accessing the course from outside of Canada or the USA **must notify the instructor** and indicate in which country they are located. Access to software may be restricted from some countries and failure to comply with these restrictions may result in criminal prosecution.

Course Objectives

In this course we will cover basic solid-state theory; properties of semiconductors; principles of metal-semiconductor junctions, p-n junctions and transistors; and optoelectronic processes.

Course Content

The following topics will be covered:

- Electrons in a solid, Ohm's law, Hall effect
- Electromagnetic fields in a solid, electron as a wave, de Broglie relation
- Quantum theory: Potential barriers and tunneling
- Free-electron model for metals, thermionic emission
- Band theory of solids, semiconductors
- Electrons, holes and effective mass
- Doping, law of mass action
- PN junctions: Rectification and capacitance
- Zener, avalanche and Schottky diodes
- MOSFETs, bipolar junction transistors (BJTs)
- Optoelectronics: Detectors and sources
- Dielectric materials: Polarization, ferroelectric and piezoelectric materials
- Magnetic materials: Properties, types, structures, uses.

Textbook

Principles of Electronic Materials and Devices, S.O. Kasap, McGraw-Hill, 4th edition, 2017.

Learning Outcomes

1. Summarize simple models that link the physical character of atoms and their bonding in solids to the bulk character of metallic semiconductor, dielectric and magnetic materials
2. Identify how these basic descriptions of materials underpin simple operational descriptions of electronic devices and systems including, diodes, transistors, transducers and power transformers.
3. Demonstrate a mastery of these concepts through comparisons of how different materials/ component designs can be used in examples including temperature sensing, optical detectors and data storage.

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	5	5	4		4							
2	4	4	4		5				2	2		3
3	3	4	4		5			3	2	2	2	3

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 30%
- Complementary Studies: 0%
- Engineering Science: 70%
- Engineering Design: 0%

Attributes

KB: A knowledge base for engineering

PA: Problem analysis

IN: Investigation

DE: Design

ET: Use of engineering tools

IT: Individual and team work

CS: Communication skills

PR: Professionalism

IE: Impact of engineering on society/
environment

EE: Ethics and equity

EP: Economics and project
management

LL: Life-long learning

Competency Levels

- 1 - Knowledge (Able to recall information)
- 2 - Comprehension (Ability rephrase information)
- 3 - Application (Ability to apply knowledge in a new situation)
- 4 - Analysis (Able to break problem into its components and establish relationships.)
- 5 - Synthesis (Able to combine separate elements into a whole)
- 6 - Evaluation (Able to judge the worth of something)

Grading Scale

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

CEAB Graduate Attributes Assessed

KB.4 – Recalls and defines, and/or comprehends and applies, first principles and concepts in specialized engineering science.

IN.4 – Understands appropriate safe work procedures during experiments or laboratory exercises.

Evaluation

Calculators are permitted for examinations. PDAs and other wireless electronic devices are forbidden. The student may be required to perform a hard reset on programmable calculators (programmable calculators are not required). Students must complete all assignments, laboratories, and must receive a minimum grade of 50% on the final examination in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Assignments	15	F, S	1, 2, 3
Laboratories	10	F, S	1, 2, 3
Term Test	25	F, S	1, 2
Final Examination	50	S	1, 2, 3

* Method of Feedback: F - Formative (written comments and/or oral discussion), S - summative (numerical grade)

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations on Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Requirements/Regulations

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a passing final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

 [Supplemental Information](#)

Copyright Notice

All materials provided in this course are copyright and are provided under the fair dealing provision of the Canadian Copyright Act. This material may not be redistributed in any manner without the express written permission of the relevant copyright holder.

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.