University of Manitoba | Price Faculty of Engineering
Department of Electrical and Computer Engineering

Course Outline

Instructor

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Office Hours

- By appointment – please email.

Teaching Assistant

- Omali Devanarayana
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- Prabodha Rathnayaka Mudiyanselage
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Contact Hours

- 4 credit hours
- Lectures: 3 hours per week
- Laboratories: 3 hours x 5 weeks

Prerequisites:

- ECE 2160 Electronics 2
- PHYS 2152 Modern Physics for Engineers
- MATH 2136 Mathematics for Computer Engineering
  or
  MATH 3132 Engineering Mathematical Analysis 3

Important Dates

- **Term Test**
  March 10th, 2026
  6:00PM – 8:00PM
- **Voluntary Withdrawal Deadline**
  March 19th, 2026
- **Louis Riel Day**
  February 16th, 2026
  No classes or examinations
- **Spring Break**
  February 17th – 20th, 2026
  No classes or examinations
- **Good Friday**
  April 3rd, 2026
  No classes or examinations

ECE 3600 – Physical Electronics

Winter 2026

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:

- Elementary materials science concepts, bonding, crystalline solids
- Electrical and thermal concepts in solids, Hall effect, electrical conductivity
- Elementary quantum physics, potential barriers and tunnelling, stimulated emission
- Band theory of solids, semiconductor concepts
- Fermi energy, Seebeck effect, thermionic emission, phonons
- Intrinsic and extrinsic semiconductors, recombination
- Piezoresistivity, Schottky junction, thermoelectric devices
- PN junctions, rectification, breakdown, MOSFETs, BJTs
- IC fabrication concepts, MEMS
- Optoelectronic devices: LEDs, solar cells, laser diodes, image sensors
- Dielectric materials: Polarization, ferroelectricity, piezoelectricity
- 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	A	A	D		D							
2	D	D	D		A				I	I		D
3	D	D	D		A			D	I	I	I	D

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.

Traditional Territories Acknowledgement

The University of Manitoba campuses and research spaces are located on original lands of Anishinaabeg, Ininiwak, Anisininewuk, Dakota Oyate, Dene and Inuit, and on the National Homeland of the Red River Métis.

UM recognizes that the Treaties signed on these lands are a lifelong, enduring relationship, and we are dedicated to upholding their spirit and intent. We acknowledge the harms and mistakes of the past and the present. With this understanding, we commit to supporting Indigenous excellence through active Reconciliation, meaningful change, and the creation of an environment where everyone can thrive. Our collaboration with Indigenous communities is grounded in respect and reciprocity and this guides how we move forward as an institution.

Accreditation Details

Accreditation Units

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

Graduate 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

I - Introduced (Introductory)
D - Developed (Intermediate)
A - Applied (Advanced)

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	10	F, S	1, 2, 3
Laboratories	15	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)

Student Absences

Attendance in lectures, tutorials, and laboratories is mandatory. For short-term absences due to illness or other extenuating circumstances of 120 hours (5 days) or less, students are required to complete a *Self-Declaration Form for Brief or Temporary Absence* available on the University website.🔗 This form must be submitted to the course instructor within 48 hours of the absence. (No additional documentation is required.)
Note that students are responsible to complete any missed work and must consult with the instructor to make appropriate arrangements.
For absences longer than 120 hours, students must contact the instructor and ECE Undergraduate Advisor, Tammy Holowachuk (Tammy.Holowachuk@umanitoba.ca) for further instructions.

Deferred Final Examinations

Students who miss the regular scheduled writing of a final examination, for valid medical or compassionate reasons, may be given the opportunity to write a deferred examination, subject to approval by the Associate Dean (Undergraduate). All requests for a deferred examination must be made within 48 hours of the missed examination, and must follow the procedure described on the Faculty website, without exception. Course instructors do not have the discretion to grant deferred final examinations. (https://umanitoba.ca/engineering/student-experience#engineering-student-policies)

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). This includes the unauthorized use of AI when preparing course deliverables. A student found guilty of contributing to cheating by another student is also subject to serious academic penalty. Integrity also applies to respecting copyrighted course content, which should not be distributed without the creator's permission. Uploading content for the purpose of transcription or other AI-enabled features is commonly a violation of the copyright holder's rights.

Copyright Notice

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.

Requirements and 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 they are uncertain about their standing in the course and about their potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations* 🔗, as well as the Price Faculty of Engineering *Academic Regulations* 🔗 dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, smart 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 Resources*

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.