Course Outline

Instructor
• Prof. Derek Oliver, P.Eng.
  E2-390G EITC
  (204) 474-9563
  Derek.Oliver@umanitoba.ca

Office Hours
• By appointment – please email.

Teaching Assistant
• TBD

Contact Hours
• 4 credit hours
• Lectures
  3 hours × 13 weeks = 39 hours
• Laboratories
  3 hours × 5 weeks = 15 hours

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

Course Website
https://universityofmanitoba.desire2learn.com/

ECE 3600 – Physical Electronics

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

Other References
Any Foundation-year Physics text, eg. Halliday and Resnick, Serway, Tipler

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 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, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.

Important Dates
• Term Test
  March 4th, 2015
  6:00pm-7:30pm
  E2-110 EITC
• Voluntary Withdrawal Deadline
  March 19th, 2015
• Mid-term Break
  February 16–20, 2015
  No classes or examinations
• Good Friday
  April 3rd, 2015
  No classes or examinations
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

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Evaluation

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

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<th>Value (%)</th>
<th>Method of Feedback</th>
<th>Learning Outcomes Evaluated</th>
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* 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.