ECE 330  SEMICONDUCTOR PHYSICS  Winter 2018

https://portal.utoronto.ca

Instructor: Peter Herman  p.herman@utoronto.ca  Office: GB442
http://photonics.light.utoronto.ca/laserphotronics/

Consulting Hours
- immediately after lectures or by appointment

Lectures:
Tue 4:10pm  MC252  Q&A  5:00+ pm
Wed 4:10pm  MC252  Q&A  5:00+ pm
Fri 4:10pm  MC252  Q&A  5:00+ pm
Tue 9:10am  BA3116  5+ make up Lectures*

* make-up lectures for Conference/Travel, cancelled lecture dates: Jan 30-Feb 2 and Mar 16, 20

Course Description: The course introduces the principles of quantum physics and uses them to understand the behaviour of semiconductors. Topics to be covered include wave-particle duality, Schrödinger's equation, energy quantization, quantum mechanical tunnelling, electrons in crystalline semiconductors and other physical concepts that form the basis for nanotechnology, microelectronics, and optoelectronics.

Learning Objectives: Knowledge of basic Geometric Optics, Wave Optics, including Interference and Diffraction. Using fundamental theory to model optical systems and applications, e.g. filtering. Application of knowledge base in solving optical problems. Model optical systems using mathematical theory, e.g. diffraction theory.

Course Reference Materials: 2 textbooks

• Quantum Physics of atoms, molecules, solids, nuclei, and particles - 75% of course
  Start in Chapter 2; Chapter 1 is too advanced.

• Semiconductor Physics and Devices - 25% of course
  (useful in ECE335)


• Supplementary Lecture Notes: download from UofT Portal as posted lecture-by-lecture
• **Website References:**

  - [http://www.acsu.buffalo.edu/~wie/applet/applet.old](http://www.acsu.buffalo.edu/~wie/applet/applet.old) SUNY, Buffalo offers great graphics for SC physics and devices
  - [http://www.britneyspears.ac/lasers.htm](http://www.britneyspears.ac/lasers.htm) Britney Spears (Essex Univ. Physics Grads) provide a succinct summary of SC physics

Good java applets demonstrating Quantum Mechanics concepts:
- Fourier-Waves; Electron Diffraction, Quantum wave interference,
- Photoelectric effect; Quantum Tunneling, Bound States;
- Semiconductors, Band Structure; Double Wells;

Video Demo: Double Slit
[http://www.youtube.com/watch?v=DfPeprQ7oGc](http://www.youtube.com/watch?v=DfPeprQ7oGc)

**Marks:**

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**Quiz:**

- schedule posted on course web page, 45 min, starts 11:10am, bonus marks
- returned and taken up in next tutorial time.
- closed book; 8.5 x 11, *hand-written* aid sheet(s) are permitted; no photocopies.
  - # 1: no aid sheet
  - # 2: less than one-side of single aid sheet
  - # 3: less than two-sides of one aid sheet
  - # 4: less than three-sides of two sheets
  - # 5: less than four-sides of two sheets
- aid sheets will be checked by TA during tests—do not exceed limits!
- no computers or electronic storage devices, no cell phones.

**Lab Assignments:**

- Computer programs with interpretation of graphical observations posted on course web page
- hand in ECE 330 Course Box in Sanford Fleming 1· Floor *(Box XX, Xth Floor SF)*
- marked labs are returned and solutions discussed in next tutorial time. Please put your name and student number on front page.
- late labs are not accepted.
Grading Corrections:
- Labs and Quiz: consult first with T.A. marker with clarifications about marking; then the instructor; (then … lawyer)!
- Quiz Policy: If the quiz is written in pencil or erasable pen, or liquid paper (‘white-out’) is used, the student will have forfeited the right to appeal for re-marking. Grade concerns must be made within one week of receiving the marked quiz.

Sickness and Missed Work:
- Quizzes
  - missing one quiz— cannot take advantage of best 4 of 5; no proof of illness is required
  - missing two or more quizzes — zero for missed work unless you complete the on-line Faculty Petition with appropriate supporting material for 2-, 3-, etc. missed quizzes.
- Assignments, Exam — zero for missed work unless you petition each missed event. Grade adjustment will be based on your performance in ‘related’ term work.

Tutorials: see schedule posted on course web page
- BA 3116 on Tuesdays starting either 9:10am or 10:10am (see Course Schedule Chart)
  o held weekly for 1 to 2 hr. starting Jan 9.
- Tutorials are a key part of the course dealing with the application of the lecture material to various exercises. During each session your will solve problems helped by other students and, if necessary, by the tutorial leader. Being able to solve a particular problem without assistance demonstrates how far you have advanced in assimilating the concepts and teachings of the course. In particular, once you are capable of solving various problems without resorting to the textbook, you can consider that you have achieved the dynamic knowledge of the course, that is, you understand its underlying philosophy.
- Practice problems will be posted on the course web page about 6 days before the tutorial. Answers and part solutions will be provided during the tutorial and posted on the web page prior to the next quiz
- Solutions to the Assignments will also be discussed in the tutorial
- Quizzes (45min) will be held during the second hour of the tutorial approximately every 2 to 3 weeks.
- You are encouraged to bring questions and stimulate discussions to improve your learning experience.
  • Participate and make the tutorial work for you!

Final Exam:
- marked by professor
- closed book; two-sided, 8.5 x 11, hand-written aid sheet (2 pages/4 sides), no photocopies.
- no computers, no cell phones, or other electronic aids
- an exam studying guide will post near the term end
Notes on Effective Studying

- Effective studying consists of taking lecture notes, active reading of the textbook, tutorial attendance and note taking, and solving various exercises on your own.

- If you can, read all the relevant text material before attending the lectures on a given topic. Much of learning involves discovering how new information relates to knowledge you already possess. The more you know about a particular topic, the more likely it is that you will see how some new information fits other information. If you read the relevant text chapters before you attend the lectures on a particular topic, you will learn more from the lectures and you will be able to take better notes. Review your lecture notes soon after each lecture and proceed to read and study the corresponding text sections.

- Begin studying your lecture notes by reviewing the lecture outlines. Ask yourself questions about the material; for example, ask yourself to provide definitions, to summarize the purpose, method and results of studies.

- Active reading involves several steps. First, read the title, topic and subtopic headings, and the summary at the end of each chapter, in order to get an overall sense of what the chapter is about.

- Read the chapter “in chunks”. The size of these chunks should be determined by natural breaks in the text, and by your ability to assimilate the material being read. Make brief notes in the margins of the text as necessary. It is inadvisable to make extensive notes from the textbook. However, it is helpful to make one or two-page summary notes per chapter showing the major headings and key concepts.

- Try to relate these summaries to various problems that you attempt to solve. In general, study as if you were going to write an examination the next day.

- The development of a compact organized aid sheet is intended to be a critical part of the learning process for this course.

- Turn off mindless distractions: email browsers, instagram, facebook, twitter, cell phone and control your own schedule!!

- Love the topic—play with your curiosity to pose questions, turn on interest, and develop into passion for the subject to pull you forward!