

PH32046 Electronic and optical properties of matter, part 1

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Chapter 1 Introduction to the course

These notes relate to the first part of the course, taught by D. Wolverson.

There will be two one-hour lecture slots each week and a problems class every other week. Solutions to the problem sheets will be released on moodle throughout the course. Lectures will use a mix of powerpoint and handwritten notes and will be recorded; the lecture notes in moodle (this document) will contain a more formal, condensed version of what is covered in lectures.

Learning outcomes (both parts)

After taking this unit, the student should be able to:

- relate the electronic and optical properties of materials to their band structure, densities of electronic states and doping profiles;
- make quantitative estimates of the parameters that govern the electronic and optical behaviour of real materials;
- describe the operation of field effect devices and PN diodes;
- describe optical absorption and emission processes in insulators semiconductors and metals;
- describe the operation of optical devices based on PN junctions.

Plan for part one

- Review of band theory and its relationship to the electronic and optical properties of materials.
- Introduction to tight binding theory.
- The electronic density of states as well as other key band structure parameters and examples of them in real materials.
- Phenomenology and theory of optical absorption and emission processes in semiconductors and insulators.
- Models of electronic absorption in semiconductors as well as reflectivity and plasmons in metals.

1.1 Suggested textbooks

Parts of this course owe a great deal to the excellent recommended textbook by Prof. Mark Fox (Sheffield) and also the classic textbook by Prof. Charles Kittel (Berkeley):

- “Optical Properties of Solids” by M. Fox. Available as an e-book through the library and features on the library list.
- “Introduction to Solid State Physics” by C. Kittel (any edition). Hard copies are available in the library. Many other nearby books with similar titles will be equally good!

Relation of PH32046 to other courses

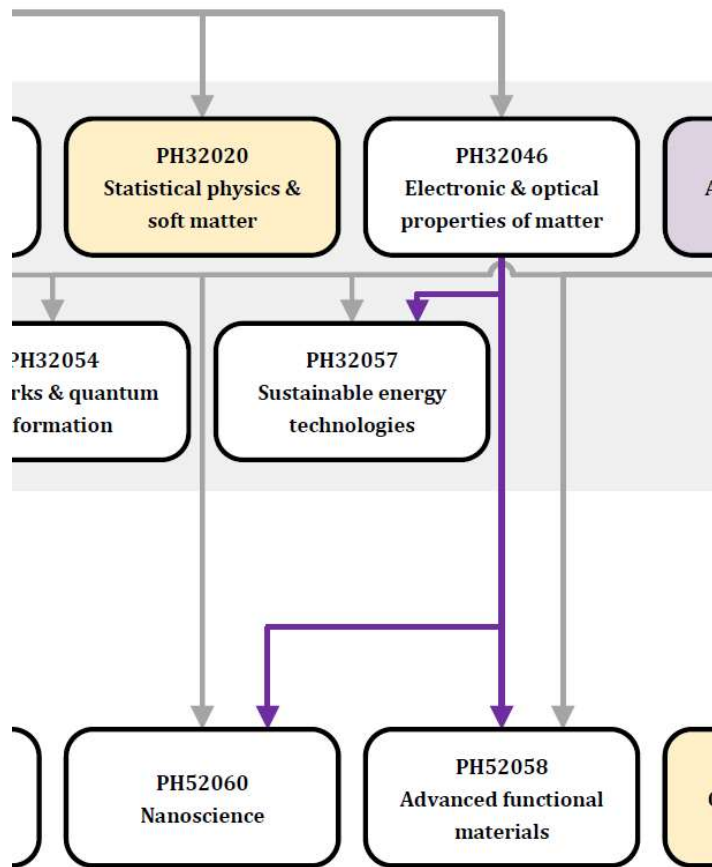


Figure 1.1: Relation of PH32046 to other courses, with thanks to Dr Yarden Brody.

- This course will use a lot of material taught in Foundations of Physics I and II;
- It is a prerequisite for PH32057 next semester and for PH52060 and PH52058 next year.