

# PHYS412

## Aims

The aim of this course is to get to know some aspects of contemporary solid state physics and nanotechnology (as well as some topics related to brain-like computing) through a guided learning approach. You will work collaboratively to research new topics, and write a report on the topics you have investigated.

The aim is for you to collectively develop an understanding of a research area / paper by exploring **basic physics topics** underlying that paper. The topics will be related to some aspect of the underlying physics, growth, fabrication and operation of nano-electronic devices. While I expect you to find and read **some** additional material / papers and show you have explored **some** related material I do not expect you to do significant literature searches. [You should mainly be reading textbooks, the wealth of material online, and non-technical articles, **not** research papers.]

It is expected that the class will be able to learn from each other. To facilitate this, each of you needs to include a summary of the main points from each of the other's reports in your own report. Remember that the exam will probe whether you have understood the research paper we are focusing on, so you will need to understand each others reports.

Lectures will be used for discussion as needed. It is obviously important that all students will participate in the discussion. Failure to get involved will result in loss of marks.

## Lectures

- Monday 2 p.m.
- Tuesday 10 a.m.
- Thursday 4 p.m.

Later in the term we will probably not use the Monday lecture.

## Overall Assessment

- Two Reports (**9 am** 20 March and **9 am** 22 May): 40%
- In-class participation 10% (1% per week)
- Learn site Wiki Journal: 10% (1% per week)
- 2 Tests (27 March and during the exam period): 40%

## Useful Material

You will mostly need to do your own research but here are a couple of suggestions:

- (Introduction to) Solid State Physics by Hook & Hall.  
e-book available on library website:  
<https://ebookcentral.proquest.com/lib/canterbury/detail.action?docID=1212553>
- The magazines *Physics World*, *Physics Today*, *Nano Today* are all at a good level.

## Workload

- A 15 point course is considered to require 150 hours of work. You should spend *at least* a solid 8 hour day each week on this course.
- We will work in two concentrated 5 week blocks, leaving the last week of the term free, except for a test.

## Learning Outcomes

One of the key learning outcomes will be an appreciation of how valuable writing is as a way of organising your thoughts and of **learning**.

At the end of this course you will have learned:

- how to read a complex scientific paper, break it down into its important components, and develop an understanding of the key ideas
- a basic understanding of electronic band structures and of the functioning of solid-state devices, and how they are related
- the reasons that certain electronic devices are considered to be important and what the state-of-the-art devices can do
- some key experimental methods that are important in understanding the basic physics of solid-state devices
- how to write a report describing a complex field without understanding every detail, and how to present your work clearly
- how to use the library, find useful papers, websites etc etc and how to cite them correctly

## Wikis

You will have a personal wiki page for each of the two projects / for each term. Your wiki must include two sections.

1. Report
2. Journal

## Your Journal

So that you can all keep track of what each of the others is doing you need to use part of the wiki as a diary. You should, for example, include links to references and websites you have found useful, and especially make brief notes on what you have understood and important questions. Note that the emphasis is on **brief notes** (simple **bullet points are good**) that make it clear which direction your investigation is going in, and especially the things you have really understood or the important questions you have. Your wiki is **not** supposed to be cover every little thing you do.

I expect that you will make entries of this kind on **at least three days** each week. You will get 1% of the course mark for each week that you do this (i.e. for the first five weeks of each project). You should read and may comment on other people's wiki's but **not** make changes to their work.

## Your Report

- The aim is to **describe** the important physics in a way that is understandable to a 4<sup>th</sup> year student who is **not** doing this class.
- **Maximum** 3500 words, minimum 3000 words. Figures **not** included. **I will enforce this limit strictly.**
- **In addition** you need to write half a page summarising **each** of the other students' reports / wikis. This needs to be in the form of **a separate pdf document emailed to Simon before the deadline.**
- References are not counted in the word limit. Make sure you give references to the place you found any figures that you use.
- You may include a **maximum** of 1000 words that describe other papers / related literature to show that you have got a sense of the broader context for the main paper we are focusing on.
- Appendices are allowed but are **included** in the page count

- Mathematical derivations should be referenced and only key equations given - there is no value in copying maths from a book or paper. Use latex to generate equations or simply a screen shot from a paper and insert them into your wiki as an image
- You **must**
  - Agree on your topics with Simon **before** you start writing the main report
  - The report must be in the form of “a decent draft” one week before the due date so that Simon can give feedback.
- Format:
  - Copy the format of Simon’s wiki, which is your template. Note in particular that you should **use the Headings 3-5 and paragraph formats only**, so that the automatic formatting works correctly, and builds a table of contents for you. No variations on this format are allowed.
  - Include appropriate introduction (explaining what the report is about and why you have written it), headings, figure captions etc.

## Report Assessment

Scores for each report will be based on

<b>Presentation</b> (images, style, english, referencing) and <b>clarity</b> (correct level, logical, well thought out)	40%
<b>Physics Content</b> (correctness, completeness, depth of understanding)	50%
<b>Summary of other students reports</b> (demonstrate understanding)	10%

## AI and plagiarism

You may quote from another source if you give a reference and make it clear that it is a quote.

Copying other work is forbidden – that is plagiarism.

Learn tools allow identification of plagiarism and of AI use. In any case of suspicious activity you may be required to attend an oral examination, the result of which may modify your marks for any or all pieces of assessment.

### Generative AI tools must not be used in this course

You are strictly prohibited from using generative artificial intelligence (AI) to generate any materials or content related to the assessment. This is because *students are expected to solve problems and demonstrate knowledge and understanding without the assistance of AI*. The use of AI-generated content is not permitted and may be considered a breach of academic integrity. Please ensure that all work submitted is the result of your own human knowledge, skills, and efforts.