INTRODUCTION TO PHYS412 FOR 2023

ADVANCED SOLID STATE PHYSICS (AND NANOTECHNOLOGY)

Lecturer: Simon Brown (*~18 lectures*)
Room: West 808 (temporarily)

Solid state physics and nanotechnology are among the most important subjects in modern physics – they underpin the understanding of modern electronic devices and are the basis of many, many new physics discoveries (check out the list of Nobel prizes in the last 40 years e.g. graphene, the quantum Hall effect, integrated circuits). At the core of these subjects is the behaviour of the electrons in materials, which can be understood using quantum mechanics.

*The aim of this course is for you to learn about **band structures** i.e. the electronic properties of metals and semiconductors, and especially the concepts of **k-space** and the Fermi surface. These allow us to understand the main properties of many materials and are essential for an understanding of most current research in solid state physics / nanotechnology.*

The final section of the course focuses on modern devices (e.g. transistors, semiconductor lasers) that use the understanding we will have developed.

Textbooks

(Introduction to) Solid State Physics by:

Hook & Hall (Recommended – a bit easy)
Note: e-book available on library website:
https://ebookcentral.proquest.com/lib/canterbury/detail.action?docID=1212553

Ashcroft & Mermin (Recommended – a bit hard)
Myers (Recommended – a bit easy)
Kittel (Not recommended by me!)

SHORT COURSE OUTLINE

	No. of lectures
▪ Part I: Band Theory Lectures	~ 12
▪ Part II: Low Dimensional Semiconductors and Devices	~ 6

Notes

1) Often you will find that the exercises highlighted in the lecture notes are very similar to the assignment problems, so don't throw your notes/working away!

2) I intend to teach only 2 lectures a week for the first 5 weeks of term 1, and then revert to 3 lectures a week after that, so that we can finish well before the end of the semester.

Assessment

3 Assignments	7% each
1 Test: (*Probably on Monday 27 March*)	9%
1 Presentation/2 page report	10%
Total Internal Assessment	*40%*
Exam	*60%*

Presentation/Report

Report **(10%)**

Provide a 2 page report that explains concisely the important physics contained in a relevant recent article at a level similar to Scientific American, Physics Today or Physics World or similar journal. Begin by browsing recent issues of those journals and identifying a couple of articles related to solid state physics / nanotechnology that seem interesting to you.

- Check the content with Simon **BY 27 February**
- Format: 12pt font, 2 cm margins, A4 page
- Give a good draft to Simon **BEFORE 13 March**

You should aim to explain *why* this is exciting physics – as though you are asking for money to do research on the topic – and not just the details of the physics.

(By the way, academics have only ONE page available when they request research funding from the Marsden Fund. Less than 10% of applications are funded – so the applications need to be really good).

You should include an extra 1-2 pages of diagrams and references to support your report.

Significant penalties will be applied for failure to meet any of the deadlines!!

Final Deadline: 5pm 22 March, under Simon's door (West 808)

Presentation **(compulsory – but not assessed)**

Prepare a **powerpoint** presentation based on your report. It should last no longer than 5 minutes. Emphasise what is new and exciting about the physics as well as the important details.

The powerpoint file will need to be emailed to Simon prior to the date of the presentations.

To be presented on Mon 20 March.