PHYS4450 Solid State Physics (Jan-April 2013)

Learning Outcomes

1.	To give an introductory survey on the physical properties of crystalline solids, with emphasis on the underlying physics.
2.	To arouse the students' interest in solid state physics.
3.	To illustrate how physics works in the context of solids.
4.	To prepare students for going deeper into the subject in the future and for self-learning of other topics not covered in the course.
5.	To cultivate an appreciation on the far-reaching contributions of physics to mankind, within the context of solid state physics.
6.	To cultivate an appreciation on using qualitative arguments, physical pictures of physics principles, and on the applications of physical concepts developed in different fundamental subjects to the understanding of the properties of solids.
7.	To provide experience on self-learning and/or peer-learning and presentation.

"Textbook"

*C Kittel, "Introduction to Solid State Physics", 8th edition, John Wiley & Sons. [QC176.K5] (This is a classic textbook that has educated generations of physics students. It has many useful data and gives an excellent discussion on various solid state phenomena. Our treatment, at places, will be more theoretical than this book. 5 copies (different editions) are put on reserve in the library.)

E-books (available via CUHK Library site)

J.J. Quinn and J.S Yi, "Solid State Physics: Principles and Modern Applications". (This is a newly published book that covers both basic and advanced topics. Part 1 (the first 9 chapters 270 pages) of the book covers much of the contents of our course.)

Henri Alloul, "Introduction to the Physics of Electrons in Solids" (English version published by Springer in 2011) [The first 4 chapters give a very nice discussion on the electron part of our course. The other chapters are also very readable.]

References

*# J Richard Christman, "Fundamentals of Solid State Physics", John Wiley & Sons, 1988. [QC176.C47] (An excellent survey on solid state physics with a good balance between phenomena and theories. An excellent book to read in conjunction with Kittel's book.)

% James D Livingston, "Electronic Properties of Engineering Materials", John Wiley & Sons, 1999. [TK7871.L59 1999] (A book in the MIT Series in Materials Science & Engineering. The author gives a lively discussion on the underlying physics, both classical

and quantum, of solid state physics, with emphasis on how physics and applications can go hand in hand. It is rather easy to read.)

*# J R Hook and H E Hall, "Solid State Physics", John Wiley & Sons, 1991. [QC176.H66] (A British classic belonging to the Manchester Physics Series. It is a good textbook in the real sense of the word -- written in a friendly way for students to read and learn. The level is right at that of a final year student in the British 3-year system.)

黃昆 著、韓汝琦 改編："固體物理學"，高等教育出版社，1998 年重印。〔中國固體物理經典課本。作者是中國半導體物理的一代宗師。我在本科生年代時也讀過這本書。〕[See also many other Chinese textbooks with the same title 固體物理學.]

* H. Ibach and H. Luth, "Solid State Physics: An introduction to principles of materials science", Springer 1995. (Another book with a good balance between discussions on experiments and theories.) [e-book is available via Library site]

*# M.A. Omar, "Elementary solid state physics : Principles and applications". (It is an easier book that assumes less background knowledge, and clearly written.)

*# Michael de Podesta, "Understanding the Properties of Matter" (Taylor and Francis) (1996). (A wonderful book that starts every discussion based on real data of materials. It also covers liquids and gases. Discussions are based on simply physics.)

* Richard Dalven, "Introduction to Applied Solid State Physics" (Plenum Press 1990). (This book is one-of-a-kind. The author succeeded in combining the "physics" and "applied" sides together. The emphasis is on physics, but the topics are chosen with applications in mind and the references guide the readers to go deeper. If you want to learn about the physics of the applications of semiconductors, superconductors, ferromagnetic materials, and nonlinear optical properties of solids, each within 50 pages, this is the book. This is the book to read following Livingston's book.)

<u>Further Reading [slightly beyond our course]</u>

* Neil W Ashcroft and N David Mermin, "Solid State Physics", Saunders, 1976. [QC176.A83] (A standard textbook at the beginning graduate level. This is for those who have read one of the above standard undergraduate textbooks and want to learn more about the quantum theory of solids. Half of the book treats solids without considering electron-electron interaction, as what we will do in our course.)

* J.M. Ziman, "Theory of Solids". (A book famous for its hand-waving arguments. The author showed how the results from calculations can be understood and argued in physical terms.)

* O. Madelung, "Introduction to Solid State Theory". (A nice book on the quantum theory of solids, suitable for senior undergraduates and beginning graduate students.)

  E.N. Economou, "The Physics of Solids: Essentials and Beyond" (Springer 2010). (A new book written by an excellent author that focuses on the ideas and applications of LCAO method in solids.) [Available in e-book form via Library site.]

* R.A. Smith, “Wave mechanics of crystalline solids” (An old undergraduate-level textbook for students to learn quantum physics and solid state physics at the same time.)

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%Textbook of PHYS3402, which should have been put on reserve in the library.

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