Applied Quantum Mechanics (PHYS 3022)
List of Textbooks/Reference Books

See Link to reserved books under PHYS3022 (Applied Quantum Mechanics) in the University Library
See Link to reserved books under PHYS3021 (Quantum Mechanics I) in the University Library

Quantum Physics Standard Textbooks of General Coverage

The topics in each module (atoms, molecules, plus other topics) are chosen to be in line with those in standard "Quantum Physics" and "Modern Physics" textbooks, only that we will make use of more formal Quantum mechanics and go deeper into each topic in the discussions. Here are some sample textbooks.

- J.R. Taylor, C.D. Zafiratos, M.A. Dubson, *Modern Physics for Scientists and Engineers (2nd edition).* (TZD) [Reserved, nicely written, easy to follow]
- Randy Harries, *Modern Physics* [Reserved]
- R.A. Serway, C.J. Moses, C.A. Moyer, *Modern Physics* [Reserved]
- K. Krane, *Modern Physics* [Reserved]
- Ronald Gautreau, *Schaum's outline of theory and problems of modern physics* (a problem book, perfect for those who want to read worked examples and prepare for GRE subject test) [Reserved]

These books focused on discussion of the underlying physics in the chosen topics and bringing out the fascinating applications of QM. The treatments are less mathematical. Our discussions will often be deeper, more quantum mechanical and mathematical.

References (Further Reading) for Each Module

Here is a list for further reading on quantum mechanics, atomic and molecular physics, and nuclear/particle physics.

Quantum Mechanics

Our course requires the QM background as covered in QMI (PHYS 3021). Class notes of PHYS3021 in Fall 2019 are available at the course webpage http://www.phy.cuhk.edu.hk/course/2019-2020/1/phys3021/download/index.html . For class notes in Fall 2017 of the same course, see Link to PHYS3021 Class Notes (2017-18 Term 1). In particular, ideas/results of standard problems such as particle-in-a-box (1D,2D,3D), harmonic oscillator, spherically symmetrical potentials, orbital angular momentum, hydrogen atom and its orbitals, spin angular momentum

(to be discussed in this term) will be used repeatedly. In PHYS 3022, approximation methods and a better physical sense of applying QM will be developed. The following undergraduate QM books cover the necessary topics in a concise way.

- Alastair M. Rae, *Quantum Mechanics* (any edition will do) (a cute book that covers most undergraduate QM) [Reserved in U Lib]
- David J. Griffiths, *Introduction to Quantum Mechanics* (any edition will do) (chapters on time-independent and time-dependent perturbation theories, and variation principle will be useful, but less quantum physics in it) [Reserved under PHYS 3021]
- Amnon Yariv, *An introduction to the theory and applications of quantum mechanics* (another cute short book that covers the necessary QM for applied physics and materials science students) [Reserved]
- Richard L. Liboff, *Introductory Quantum Mechanics* (nicely written by a Cornell author that covers all necessary undergraduate QM) [Reserved]
- Stephen Gasiorowicz, *Quantum Physics* (a book that has more quantum mechanics than other books of the same title) [Reserved]
- Walter Greiner, *Quantum Mechanics* (the first QM course in German curriculum with many worked examples) [Reserved]

Atomic and Molecular Physics

- Donald A. McQuarrie, *Quantum Chemistry* (a book that teaches quantum mechanics with great clarity assuming no background and less mathematics, and covers all undergraduate-level atomic and molecular physics and more [postgraduate level Chemistry book]) [Reserved]
- B.H. Bransden and C.J. Joachain, *Physics of Atoms and Molecules* (also covers much formal QM, a serious book for those who want to get into atomic/molecular physics) [Reserved]
- C.J. Foot, Atomic Physics (available in e-book form via Library) [Textbook of PHYS5000 level "Modern Atomic Physics".]

Nuclear Physics

- R. MacKintosh, J. Al-Khalili, B. Jonson, T. Pena, *Nucleus: A trip into the heart of matter* (A beautiful book full of excellent illustrations but no equations.) [Reserved]
- W.S.C. Williams, *Nuclear and Particle Physics* (A more complete treatment at the final year undergraduate level. There is a later edition.) [The book and the solution manual to problems are reserved.]

- W.N. Cottingham and D.A. Greenwood, *An introduction to Nuclear Physics* [Reserved]

Solid State Physics

For those who want to see how QM works in solids (not included in PHYS 3022), see

- See Link to Solid State Physics class notes (This is a complete course that I taught some years ago. For beginners, see the parts on energy bands and lattice vibrations.)
- M.A. Omar, *Elementary Solid State Physics* [very clear introduction with minimal assumption on preparation]
- J.D. Livingston, *Electronic Properties of Engineering Materials* [An excellent book to see how classical and quantum physics can be applied to understand physical (dielectric, optical, transport, magnetic) of materials. The book emphasizes physical sense more than mathematics.]
- J.R. Christman, *Fundamentals of Solid State Physics* and C. Kittel, *Introduction to Solid State Physics* [These two books have almost identical coverage. The latter is a standard textbook from which generations of physics students learned their solid state physics.]

Practical Books for Mathematical Skills (a sample)

Don't let mathematics hinder your QM/physics learning. QM is more a physics subject than math. Here are a few practical texts that you can pick up pieces of mathematics quickly and painlessly.

- E. Steiner, *The Chemistry Maths Book* (Oxford Science Publications 1996) [Covers all mathematics needed for a chemistry degree, thus covers math skills needed for physical chemistry for which quantum chemistry is a part. Each topic is covered in only a few pages. It is under reserve in UL (under PHYS3021). Perfect for those who only want to know how to use math and afraid of knowing the detail!]
- L. Lyons, *All you wanted to know about Mathematics but where afraid to ask* Volumes 1&2 (Cambridge U Press) [Forgot what complex numbers are about or what normal modes are, you can find a friendly and often insightful and physical discussions in these two volumes. Perfect for those who are afraid of abstract math discussions but want to learn a topic more completely than in The Chemistry Maths Book.]

- K.F. Riley, M.P. Hobson, S.J. Bence, Mathematical Methods for Physics and Engineering (2nd edition) (Cambridge Univ. Press 2002) (A pow-price edition is available in Mainland). [Finally, here is a serious mathematical methods book of over 1000 pages.]

Further Reading will be given by the end of the course.

4 January 2020
PM Hui