Quantum Mechanics III

http://www.rpi.edu/~napolj/Courses/QMIII/

Textbook List for Fall 2004

August 18, 2004

Quantum Field Theory in a Nutshell *This book is required*
A. Zee, Princeton University Press (2004)
ISBN: 0691010196

This is the primary course textbook. I like it a lot, and I think you will, too. The book is written in a very colloquial manner and should be fun to use in class. Some very modern topics are discussed early on. Its emphasis is on concepts, not mathematical rigor, but we will fill in some of the gaps in class and on homework assignments.

Quantum Field Theory *This book is suggested*
F.Mandl and G.Shaw, John Wiley and Sons (1993)
ISBN: 0471941867

In his Preface, Zee mentions the textbook he liked as a graduate student. Mandl and Shaw is the most recent version of that book. It is more traditional than Zee, but I like it very much. Its only real drawback is that it is very much a book for the relativistic field theory of elementary particles, and doesn't include any applications in other branches of physics. It also doesn't include any truly modern applications in particle physics, such as string theory or gravity.

Quantum Field Theory: From Operators to Path Integrals
K. Huang, John Wiley and Sons (1998)
ISBN: 0471141208

This would have been my second choice for a primary textbook. I like the book's style, and it does cover some non-particle physics applications, but it is still mainly a traditional field theory textbook aimed at particle physicists. It is also rather expensive.

Relativistic Quantum Mechanics and Field Theory
F. Gross, John Wiley and Sons (1998)
ISBN: 0471353868

Not a bad book, but has a rather conventional approach, at least as compared to Zee. This is a revised edition, available now in paperback.

The Quantum Theory of Light, Third Edition
R. Loudon, Oxford Science Publications (2000) ISBN: 0198501765

This is a fine book on the quantized electromagnetic field and its applications in optics and other phenomena. It is too specialized for our course, however.

Quantum Theory of Many - Particle Systems
A. Fetter and J.D. Walecka, Dover (2003)
ISBN: 0486428273

An excellent book on field theory applied to condensed matter and nuclear physics, very much for the practitioner. It does not include relativistic formalism, however, and everything is built up from the second quantization formalism, which we will not emphasize.

Quantum Mechanics II: A Second Course in Quantum Theory
R. Landau, John Wiley and Sons (1995)
ISBN: 0471116084

I like this book in many ways, but it covers much material that will not be part of this course, and very much of it is aimed at "relativistic quantum mechanics", and the transition to quantum field theory is mainly in the "second quantization" formalism.

The Quantum Theory of Fields, Volumes I, II, and III
S. Weinberg, Cambridge University Press (1996, 1996, 1999)
ISBN: 0521585554, 0521550025, 0521660009

A tremendous three volume set, leading eventually to the field theory of strings incorporating supersymmetry, these are lucidly written and filled with technical detail. The "historical introduction" in the first volume is itself an outstanding read.

Relativistic Quantum Fields
J.D. Bjorken and S. Drell, McGraw-Hill (1965)
ISBN: 0070054940

Advanced Quantum Mechanics
J.J. Sakurai, Addison-Wesley (1967)
ISBN: 0201067102

Introduction to Quantum Field Theory
M.E. Peskin and D.V. Schroeder, Perseus Publishing (1994)
ISBN: 0201503972

These are the classic textbooks on the subject, all aimed mainly at particle physics.

For prerequisite material, I recommend "Theoretical Mechanics of Particles and Continua", by Fetter and Walecka, ISBN 0486432610, Dover (2003); "Modern Quantum Mechanics, Revised Edition" by Sakurai and S.F. Tuan, ISBN 0201539292, Addison Wesley (1993); and "Principles of Quantum Mechanics, Second Edition", by R. Shankar, ISBN 0306447908, Kluwer (1997). *Note:* Don't confuse the Classical Mechanics (Fetter and Walecka) and Quantum Mechanics (Sakurai) books, to which I refer in the course syllabus, and the field theory books by the same authors which I will not be using.