Course Information

Course: Quantum Mechanics III (Physics 918)

Fall 2007, MWF, 13:30 - 14:20 202 Brace

Instructor: Prof. Ilya I. Fabrikant, 303 Ferguson, tel. 472-2774
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Office Hours: MWF 14:30 - 15:30

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

Text for Part 1: Lecture notes from the instructor

Text for Part 2: J.J. Sakurai, Advanced Quantum Mechanics. Addison-Wesley, 1967, or any later print.

Recommended reading:

This course requires good knowledge of the quantum-mechanical perturbation theory and classical electrodynamics. For updating/ refreshing your background in these, the following books are recommended:

1. D. J. Griffiths, Introduction to Electrodynamics, Prentice Hall, 1999.
(This undergraduate course is enough for our purposes, but you can also use Jackson, of course).

2. C. Cohen-Tannoudji et al, Quantum Mechanics, J. Wiley, 1977. Chapters VIII, XI, XIII.

3. B. H. Bransden and C. J. Joachain, Introduction to Quantum Mechanics, Longman Scientific, 1989. Chapters 8, 9, 13.

Supplemental reading for this course:

1. R. D. Mattuck, A guide to Feynman diagrams in the many-body problem.

(A simple introduction to Feynman diagrams).

2. Kerson Huang, Quantum Field Theory: From Operators to Path Integrals
(John Wiley, 1998).
(Path integrals, applications to condensed-matter physics.)

3. A.A. Abrikosov, L. P. Gorkov, I. I. Dzyaloshinski, Methods of quantum field theory in statistical physics. Dover, 1963.
(Advanced-level applications of quantum field theory to condensed matter physics).

4. V.B. Berestetskii, E.M. Lifshitz and L.P. Pitaevskii, Quantum Electrodynamics (Pergamon, 1982).
(An advanced relativistic QED course with more QED processes considered.)

Outline: (1) Quantum field theory and its application to many-body Bose and Fermi systems
(2) Quantum theory of radiation (nonrelativistic QED).
(3) The Dirac equation and its applications

Homework: specific assignments and due dates to be given in class; Homeworks turned in after the due dates lose two points per day. No homework is accepted one week after the due day.
In case of illness or a personal emergency the new terms should be negotiated with the instructor.
In doing homework you are allowed to discuss problems with each other, but you are NOT allowed to cooperate on writing down the solutions on the paper.

Exams: four quizzes, one Midterm Exam and Final Exam. All quizzes are closed-book. At the exams you are allowed to use the textbook and the handouts (instructor's lecture notes), but not allowed to use any other notes.

QUIZZES (in-class): 9/14, 10/3, 11/2, 11/19

MIDTERM EXAM: Thursday, 10/18, 17:30-19:30 (tentative)

FINAL EXAM: Monday, 12/17, 13:00-15:00

Grades: midterm exam - 30%; final exam - 30%; quizzes - 20%; homework - 20%

Tentative grade scale

%	grade

>96%	A+
90-96%	A
85-90	A-
80-85	B+
75-80	B
70-75	B-
65-70	C+
60-65	C
55-60	C-

Tentative schedule

8/27- 8/31	Introduction. Many-body systems in quantum mechanics. Bosons and fermions.
9/3	LABOR DAY
9/5 - 9/7	Second quantization and many-body theory. Dilute Bose gas.
9/10- 9/14	Quasiparticles. Phonons. Dilute Fermi gas.
9/17- 9/21	Green's function and propagator for Schroedinger equation
9/24- 9/28	The interaction representation. Perturbation theory. The Green's functions in the field theory. Sakurai, 4-2.
10/1 -10/5	Basic principles of the diagram technique. Electron-phonon interaction.
10/8 -10/12	Diagram technique in the momentum space. Partial summation of diagrams. Hatree-Fock approximation for electron gas.
10/15-10/19	Polarization diagrams for electron gas. Theory of superconductivity.
10/22	FALL BREAK
10/24-10/26	Classical radiation field and its quantization, Sakurai, Sec. 2-1, 2-2.
10/29-11/2	Quantized radiation field. Emission and absorption. Sec. 2-3, 2-4.
11/5 -11/9	Photoionization and photodetachment. Rayleigh scattering and Thomson scattering. Sec. 2-5, 2-6.
11/12-11/16	The electron's self-energy. Mass renormalization.

	Nonrelativistic treatment of the Lamb shift. Sec. 2-8.
11/19	The Dirac equation. Sec. 3-2 (pp. 78-83).
11/21-11/23	THANKSGIVING BREAK
11/26-11/30	Nonrelativistic approximation. Free-wave solutions. Dirac operators in the Heisenberg representation. Sec. 3-3, 3-6.
12/3 -12/7	Negative-energy solutions. Hydrogen atom. Sec. 3-6, 3-7, 3-8.
12/10-12/14	Holes and positrons. Review and discussion. Sec. 3-9

Grade scale out of 125: 67.8%

>96%	A+
90-96%	A
85-90	A-
80-85	B+
75-80	B
70-75	B-
65-70	C+
60-65	C
55-60	C-