Physics 522 – Quantum Mechanics II
Spring 2009

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Office hours: 11:30AM-12:30PM Tue/Thu, or by appointment

Lecture hours:
9:40-10:55 Tue/Thu
Nielsen Physics 415

Course description: This course teaches advanced topics in theoretical quantum mechanics and builds on the course Physics 521
Prerequisites: Quantum Mechanics I (Physics 521) or equivalent

Literature: The class is based on chapters from several different books and articles. Further literature will be announced in class.

[B] Bethe and Jackiw, *Intermediate Quantum Mechanics*
[D] Dalfovo *et al*., Rev. Mod. Phys. 71, 463 (1999)
[K] W. Kutzelnigg, Journal of Molecular Structure: THEOCHEM 768, 163 (2006)
[L] Leggett, Rev. Mod. Phys. 73, 307 (2001)
[La] Landau and Lifshitz, *Quantum Mechanics*
[LL] Landau and Lifshitz, *Statistical Physics 2*
[Mr] Merzbacher *Quantum Mechanics*
[Ms] Messiah *Quantum Mechanics*
[PS] Pethick and Smith, *Bose-Einstein Condensation in Dilute Gases*
[St] R. Stock *et al*., Phys. Rev. Lett. 94, 023202 (2005)

Academic honesty: All work submitted by a student is expected to represent their own work. Students are expected to perform all work in conformance with the University policies regarding Academic Honesty.

Disability statement: If you need course adaptations or accommodations because of a documented disability, please contact the Office of Disability Services at 2227 Dunford Hall (telephone/TTY 865-974-6087; e-mail ods@utk.edu) by January 16. This will ensure that you are properly registered for services.

Grading policy: The semester grade will be a weighted average of homework scores, mid-term exam, final exam, and class attendance.

Homework will comprise 55% of the final semester grade.
Homework will consist of problems that each student has to solve within one week after the homework assignment. Due dates for problem sets are firm. In lieu of extensions, the lowest score on homework sets will be dropped from the average.

The mid-term exam will comprise 20% of the final semester grade. The mid-term exam will be administered during class. Class notes may be used.

The final exam will comprise 20% of the final semester grade. The final exam will be comprehensive. Date and place will be announced in class.

Class attendance is required, and classes will start on time. You can earn up to 5% of the final semester grade by arriving on time. You also need to read the relevant

material before class, so that you are familiar with basic definitions. Class time will be used to focus on concepts and understanding.

Schedule: The class will meet 30 times. There will be 28 lectures, the mid-term exam, and the final exam. **The schedule below is tentative. Any changes will be announced in class.**

Week	Date	Lecture	Material	Reading
1	8-Jan	1	Introduction: course overview	
2	13-Jan	2	Scattering: Born approximation	[Mr:13]
	15-Jan	3	Pseudo potentials & short-ranged interactions	[St], [L:4]
3	20-Jan	4	Symmetry and QM	[Mr:17], [La:12], [Ms:13]
	22-Jan	5	Symmetry and QM II; identical particles	[Mr:17,21], [La:9,12], [B:2],[Ms:14]
4	27-Jan	6	Helium atom – para helium and ortho helium	[Mr:18], [B:3]
	29-Jan	7	Molecules; Born-Oppenheimer approximation	[B:9], [Mr:8], [Ms:18]
5	3-Feb	8	Electrons in a magnetic field – Landau levels	[La:16]
	5-Feb	9	Landau levels, quantum Hall effect	[La:16]
6	10-Feb	10	Thomas-Fermi approximation	[B:5]
	12-Feb	11	Second quantization I	[Mr:21], [La:9]
7	17-Feb	12	Second quantization II	[Mr:21], [La:9]
	19-Feb	13	Bose-Einstein condensation	[PS:6], [L:3]
8	24-Feb	14	Gross-Pitaevskii equation – cold atom gases	[PS:6], [L:5]
	26-Feb		**Mid-term exam**	
9	3-Mar	15	Mean-field theory, Hartree-Fock equation	[B:4], [Mr:22], [Ms:18]
	5-Mar	16	Atoms and nuclei – shell structure	[La:10], [Ms:18]
10	10-Mar	17	Density-functional theory	[K]
	12-Mar	18	BCS theory – superconductivity	[PS:10]
11	17-Mar		**Spring Break**	
	19-Mar		**Spring Break**	
12	24-Mar	19	Superfluidity – behavior under rotations	[L:6], [LL:3], [PS:9]
	26-Mar	20	Emission and absorption of light I	[B:10], [Mr:23]
13	31-Mar	21	Emission and absorption of light II	[B:10], [Mr:23]
	2-Apr	22	Path integrals I	[Mr:15]
14	7-Apr	23	Path integrals II	[Mr:15]
	9-Apr	24	Relativistic QM: Dirac equation I	[Mr:24], [Ms:20]
15	14-Apr	25	Dirac equation II	[Mr:24], [Ms:20]
	16-Apr	26	Dirac equation III	[Mr:24], [Ms:20]
16	21-Apr	27	Antiferromagnetic spin chain – Bethe ansatz	
	23-Apr	28	Aharonov-Bohm effect	
	28-Apr		**Final Exam**	