**PHYS 625 NON-RELATIVISTIC QUANTUM MECHANICS SPRING 2012**

1. Lectures: M-W 12:30 - 1:45 p.m., Room - Physics 1219.

2. Instructor: T. R. Kirkpatrick Office: IPST Building (085), Room 1110, Telephone 301-405-4801

3. Office Hours: By appointment after class. E-mail: tedkirkp@umd.edu

4. Relevant Textbooks: ***Quantum Theory of Many Particle Systems*** by A. L. Fetter and J. D. Walecka ***Many-Body Quantum Theory in Condensed Matter Physics*** by Bruus and Flensberg, and ***Methods of Quantum Field Theory in Statistical Physics*** by A. A. Abrikov, L. P. Gorkov, and I. E. Dzyaloshinski: (AGD)

5. Grade Weighting: Homework: Given every four weeks or one term paper (will decide).

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I. Introductory Material

(i) Second Quantization

(ii) Model Hamiltonians

(a) electron gas model

(b) tight binding models - The Hubbard Model

(c) spin Hamiltonians

(d) The Anderson Model

(iii) Coherent States

(a) Boson coherent states

(b) Grassmann algebra

(c) Fermion coherent states

II. Green’s Functions at Zero Temperature - The Canonical Quantization Approach

(i) Pictures

(ii) Definition of Green’s Functions

(iii) Feynmann Diagrams and Perturbation Theory

(iv) Physical Content of Self-Energies

III. Green’s Functions at Finite Temperatures

(i) Canonical Quantization Approach

(ii) Perturbation Theory

(iii) Analytic Properties

(a) Zero temperature Green’s functions

(b) Finite temperature Green’s functions

(iv) Real-time Green’s functions and linear response

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IV. The Fermi and Electron Gas Problems

(i) Hartree-Fock Approximation

(ii) Screening in an electron gas

(iii) Zero sound in an imperfect Fermi gas

(iv) Plasma oscillations in an electron gas

V. Superconductivity (conventional)

(i) Experiments

(ii) Cooper instability

(iii) Gorkov theory - BCS theory

(iv) Field theory approach

(v) Thermodynamics of SC state

(vi) Transport in superconductors

VI. Magnetism

(I) Experiments

(ii) Ferromagnetism

(iii) Antiferromagnetism