PHYS 625 NON-RELATIVISTIC QUANTUM MECHANICS SPRING 2007

1. Lectures: M-W 12:30 - 1:45 p.m., Room - Physics 4220

2. Instructor: T. R. Kirkpatrick

   Office: IPST Building (085), Room 1110, Telephone 301-405-4801

   Office Hours: By appointment after class

   E-mail: tedkirkp@umd.edu

3. Relevant Textbooks:

   Quantum Theory of Many Particle Systems by A. L. Fetter and J. D. Walecka

   Quantum Many-Particle Systems by John W. Negele and Henri Orland

   Many-Particle Systems by G. D. Mahan

   Methods of Quantum Field Theory in Statistical Physics by A. A. Abrikov, L. P. Gorkov, and I. E. Dzyaloshinski: (AGD)

4. Grade Weighting:

   Homework: Given every four weeks

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

IV. <u>The Fermi and Electron Gas Problems</u>

(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. <u>Superconductivity (conventional)</u>

(i) Experiments

(ii) Cooper instability

(iii) Gorkov theory - BCS theory

(iv) Field theory approach

(v) Thermodynamics of SC state

(vi) Transport in superconductors

VI. <u>Magnetism</u>

(I) Experiments

(ii) Ferromagnetism

(iii) Antiferromagnetism