编号：L113C021

课程名称：量子多体理论

英文名称：Quantum Many-body Theory

1．Class Hours (课内学时)： 32 Credits（学分）：2

2．Majors Concerned (适用专业) ：Applied Physics, Theoretical Physics

3．Preparatory Courses（预修课程）：Quantum Mechanics, Statistical Mechanics, Solid State Physics

4．Teaching Purpose (教学目的) ：To increase basic knowledge and rules in many-body physics, to enhance ability of solving physics problems in many-body theory, to help establish condensed matter physics intuition and pictures, and to incentive interest in scientific research.

5．Teaching Method(教学方式) ：Lectures and Homework.

6．Introduction to the Course (课程简介) This course is part of the core curriculum for theoretical physics and other related graduate majors. The main content is to introduce various theories in quantum many-body problems and its applications in the condensed matter physics. Through this course, students will learn the modern many-body theory and basic methods of handling many body problems.

7．Main Contents and Requirement for Students (教学主要内容及对学生的要求) ：

1. Introduction (2 hours)
   1. General Remarks on Quantum Many-body Problems
   2. The development of Quantum Many-body Theory
2. Second Quantization (4 hours)
   1. Quantum Mechanics and Operators
   2. Identical Particles
   3. Creation and Annihilation Operators
   4. Electron-Phonon Coupling
3. Green’s Function (4 hours)
   1. Green’s Function
   2. Fluctuation-Dissipation Theorem
   3. Wick’s Theorem
   4. Feynman Diagram
   5. Dyson Equation
4. Hartree-Fock Theory and Density Functional Theory (10 hours)
   1. Introduction
   2. Hartree-Fock Equations
   3. Exchange and Correlation Interactions
   4. Basis Theorems of Density Functional Theory
   5. Kohn-Sham Equations
   6. Local Density Approximation and Generalized Gradient Approximation
5. Linear Response Theory (10 hours)
   1. Perturbation Theory and Linear Response
   2. Linear Response Function
   3. Periodic Perturbation
   4. Spectral Representation
   5. Density Response
   6. Lindhard Function
6. Referencing Textbooks and Required References for Students (参考书及学生必读参考资料) ：

References include:

* 1. Many-Particle Physics, Gerald D Mahan，2008, Springer
  2. Quantum Theory of Electron Liquid, Gabriele Giuliani and Giovanni Vignale, 2005, Cambridge University Press
  3. Nobel Lecture: Electronic Structure of Matter-Wave Functions and Density Functionals, Revs. of Mod. Phys.,71, No.5, 1253 (Oct.1999)

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10．Teacher (任课教师) ：Kai Luo

Signed by Director（教研室主任签字）：

Signed by Dean（学院分管领导签字）：