清華大學物理系博士資格考命題範圍

量子力學部份

References:
Principle of Quantum Mechanics, R. Shankar
Or
Modern Quantum Mechanics, J.J. Sakurai
Or
Textbooks that were used in the past two years

考試範圍

- **Fundamental Concepts: usage of kets and bras, wavefunction in position and momentum space, properties of Hilbert space, properties of observables, uncertainty principle, constants of motion…etc..**
- **Correspondence principle and quantization rules**
- **Time-independent Schrodinger equation in 1D, 2D, and 3D**
- **Quantum Dynamics: time evolution of the state, the Schrodinger and Heisenberg picture, dynamics of two-level systems**
- **Hydrogen -like atoms**
- **Simple Harmonic Oscillators**
- **Rotation and the Theory of Angular momentum (including spins and the addition of angular momentum)**
- **Identical particles**
- **Symmetry in Quantum Mechanics**
- **Approximated method: WKB method, low-order time-independent and time-dependent perturbation theories, variational method**
- **Scattering theory: scattering amplitude, cross section, Born approximation and phase-shift analysis**
- **Charged particles in EM fields**
- **Applications of the above methods**

清華大學物理系博士資格考命題範圍

統計力學部份

References:1. Kittle and Kroemer: Thermal Physics CH.1-13

Or

Greiner, Neir and Stocker: Thermodynamics and Statistical Mechanics.

(For thermodynamics, fundamentals of statistical mechanics and applications)

2. R. K. Pathria: Statistical Mechanics CH 1-8

Or

K. Huang: Statistical mechanics (2nd Ed. CH 6-8,11,12)

(For graduate-level methods)

考試範圍

1. **Thermodynamics and its statistical basis**
2. **Ensemble Theories**
   Includes: The microcanonical ensemble;
   The canonical ensemble;
   The grand canonmical ensemble.
3. **Classical and quantum statistics**
   Includes: density matrix; systems of indistinguishable particles.
4. **Theory of simple gases**
5. **Ideal Bose and Fermi Systems**
6. **Applications in Single Systems.(Examples: harmonic oscillators, photon systems, magnetic systems, the Ising model etc.).**

清華大學物理系博士資格考命題範圍

古典力學部份

References：1. H. Goldstein: Classical Mechanics

Or

2. Landau and Lifshitz: Classical Mechanics

考試範圍	參考資料	
1.Variational principles and Lagrange's equations	**Ref. 1**	**Ref. 2**
(Includes: Single and many particle systems;	**CH.2**	**CH.1**
Conservation theorems;		
Symmetry properties)		
2. Two-body central force problems		
(Includes: center-of-mass frame; planetary motion;	**CH.3**	**CH.2,3**
Kepler Laws; virial theorems;		
Scattering cross sections)		
3. Rigid body	**CH.4,5**	**CH.5**
(Includes: inertial tensor, moment of inertia;		
Euler's theorem; Coriolis force;		
Heavy symmetry top)		
4. Small oscillations;	**CH.6**	**CH.4**
(Includes: free oscillations; forced oscillations;		
damped oscillations; coupled oscillators)		
5. Canonical Equations	**CH.8,9,10**	**CH.6**
(Includes: Hamilton's equation;		
canonical transformations;		
Hamilton-Jacobi equation;		
Action angle variables)		

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電動力學部份

Reference：Jackson：Classical Electrodynamics

考試範圍

CH.1-7 Electrostatics; Magnetostatics;
Time-Varying Fields, Maxwell Equations,
Conservation Laws; Plane Electromagnetic Waves and Wave Propagation

CH. 11 Special Theory of Relativity

***CH.14 Radiation by Moving Charges**

***註：是否包括CH.14,在課程委員會討論時未達成共識。**