Syllabus: Quantum and Statistical Mechanics

Part 1: Quantum Mechanics

Basic postulates of quantum mechanics, Stern-Gerlach experiment and spin, Kets, Bras and
operators, Wave functions.
Schrodinger equation, Schrodinger and Heisenberg picture, Simple Harmonic Oscillator,
Potential and Gauge transformations, Bohm-Ahronov effect, Berry phase.
Symmetries, conservation laws, and degeneracies, Continuous and discrete symmetries.
Theory of angular momentum, Addition of angular momentum, *Bell's inequality, Tensor operators. Identical particles.

*Path integral approach to quantum mechanics.

Reference Books:
1. Introduction to Quantum Mechanics by D. J. Griffiths.
2. Modern Quantum Mechanics by J. J. Sakurai.
3. Principles of Quantum Mechanics by R. Shankar.

Part 2: Statistical Mechanics

Fundamental principles of statistical physics, Ergodicity and approach to equilibrium, Liouville's equation and microcanonical distribution, Irreversibility and *Poincare recurrence theorem, *Thermalization of quantum systems.

Statistical ensembles, The Microcanonical, Canonical and Grand canonical ensembles.
Density operators and pure versus mixed ensembles.

Ideal Bose and Ideal Fermi gases.

Phase Transition and critical phenomena: first and second-order phase transitions, order parameter, critical exponents, scale invariance.

Reference Books:
1. Fundamentals of Statistical and Thermal Physics by F. Reif
2. Statistical Mechanics by K. Huang.
3. Statistical Physics Part-1: L. Landau and E. Lifshitz.