Phys 2566 Syllabus (Spring, 2016), Prof. Tao Han
Quantum Mechanics II

1 Theory of Angular Momentum (≈ 15 lectures)

1.1 Rotation of a physical system, generators and algebra

1.2 Rotation in quantum mechanics

1.3 Spin 1/2 systems

1.4 Rotational groups

1.5 Eigen-values and eigenstates of J

1.6 Orbital angular momentum and central force problems

1.7 Addition of angular momenta

1.8 Density operators, pure and mixed ensembles

1.9 Spin correlation and quantum entanglement

1.10 Tensor operators and the Wigner-Eckart theorem

2 Approximation Methods (≈ 13 lectures)

2.1 Time-independent perturbation theory: Non-degeneracy

2.2 Time-independent perturbation theory: Degeneracy

2.3 Variational methods

2.4 Interaction picture and time-dependent potential

2.5 Time-dependent perturbation theory

2.6 Application: Interaction with classical radiation field

2.7 Application: Energy shift and decay width

3 Scattering Theory (≈ 7 lectures)

3.1 Lippmann-Schwinger equation

3.2 The Born approximation

3.3 Optical theorem

3.4 Plan waves versus spherical waves

3.5 Methods of partial waves

3.6 Resonance scattering

3.7 Coulomb scattering

4 Quantum Theory of Radiation (≈ 3 lectures)

4.1 Classical radiation

4.2 Quantization of radiation field

4.3 Vacuum energy and the Casimir Effect

4.4 Interaction of the electro-magnetic field with matter

5 Relativistic Quantum Mechanics (≈ 4 lectures)

5.1 Relativistic transformation: Galilean and Einstein's

5.2 Klein-Gordon equation: Spin-0 Particles

5.3 The Dirac equation: Spin-$\frac{1}{2}$ Particles

5.4 Simple solutions; non-relativistic approximation

5.5 Negative energy solution; hole theory and charge conjugation

5.6 The two-components system