

SSP-S-314

III SEMESTER

P301: Advanced Quantum Mechanics

2005-2006

1. Linear Vector Spaces in Quantum Mechanics:

Vectors and operators, change of basis, Dirac's bra and ket notations. Eigen value problem for operators. The continuous spectrum. Application to wave mechanics in one dimension.

(Merzbacher Sec. 14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7)

2. Quantum Dynamics :

The equation of motion, Quantization postulates, canonical quantization, Constants of motion and invariance properties. Heisenberg picture. Harmonic Oscillator.

(Merzbacher Sec. 15.1, 15.2, 15.3, 15.4, 15.6, 15.7)

3. Development of time-dependent perturbation theory.: The golden rule for constant transition rates. (Merzbacher. Chapter. 18 relevant parts)

4. Addition of two angular momenta. Tensor operators.

Wigner-Eckart theorem. Matrix elements of vector operators. Parity and time reversal symmetries.

(Merzbacher Section. 16.6, 16.8, 16.10, 16.11)

5. Scattering:

Concept of differential cross-section. Scattering of a wave packet. Born approximation. Partial waves and phase shift analysis.

(Merzbacher. Section. 11.1, 11.2, 11.4, 11.5)

6. Relativistic Quantum Mechanics

Klein - Gordon equation, Dirac equation for a free particle, Equation of continuity, Spin of a Dirac particle, Solutions of free particle Dirac equation, Negative energy states and hole theory

Textbooks:

1. "Quantum Mechanics" by E. Merzbacher (John Wiley & Sons, Inc., New York)

2. "Quantum Mechanics" by R.D. Ratna Raju

Reference Books:

1. "Quantum Mechanics" by Thankappan

2. "Quantum Mechanics" by Biswas

SSP-S-316

SPECIAL PAPER - I

P303, MS 303: Fermisurfaces and Order - Disorder Transformations

(Common Paper for M.Sc. Physics & M.Sc. Materials Science)

1. Lattice Dynamics:

Anharmonic crystal interactions - thermal expansion, thermal conductivity, lattice thermal resistivity, umklapp processes, imperfections.

6 Hrs.

2. Energy bands in solids:

Nearly free electron model, origin of the energy gap - wave equation of electron in a periodic potential - Crystal momentum of an electron - Approximate solution near a zone boundary - Number of orbitals in a band - metals and insulators

8 Hrs.

3. Fermi Surfaces of Metals:

Reduced Zone scheme - Periodic Zone scheme - construction of Fermi surfaces - Electron orbits, hole orbits and open orbits - Calculation of energy bands - Tight binding method for energy bands - Experimental methods for Fermi surface studies - Quantization of orbits in a magnetic field - de Haas - Van Alphen effect - extremal orbits - Fermi surface of copper.

10 Hrs

4. Ferro Electricity:

Classification of ferro electric crystals - Polarization catastrophe - Landau theory of the phase transition - Second order transition - First order transition - Soft optical phonons - Antiferroelectricity - Ferroelectric domains - Piezo electricity - Ferroelasticity.

10 Hrs.

5. Point Defects and Alloys:

Lattice vacancies - Diffusion in metals - Colour centers - F - Centers and other centers in alkali halides - Alloys, order - disorder transformation - elementary theory or order.

8 Hrs

6. Super conductivity:

Thermo dynamics of the superconducting transition - London equation - Coherence length - the accomplishments of the B.C.S. theory - B.C.S. ground state - Type II super conductors - Vortex state - Estimation of H_{c1} and H_{c2} .

8 Hrs.

Textbooks:

1. "Solid State Physics" 5th Edition Chapters (5,7,9,12,13,17) by C. KITTEL.