

Department Elective – II
 Fifth year of Five Years integrated M.Sc. (Physics)
 M.Sc. - V, Semester – IX

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MP 551 : **Advanced Condensed Matter Physics**

- **Introductory Survey** (06 Hours)
 General considerations, Basic Hamiltonian, Elementary excitations, The measurement of the elementary excitation spectrum. Scope of the subject.
- **Electrons & Plasmas** (06 Hours)
 Sommerfeld non interacting electron gas, Hartree and Hartree-Fock Approximations, Correlation and correlation energy : an introductory survey, Dielectric response of an electron system, Properties of the electron gas in the RPA, Properties of the electron gas at metallic densities.
- **Electrons, Plasmons and Photons in Solids** (10 Hours)
 Introductory considerations, Modifications of $\epsilon(k,w)$, Experimental observation of plasmons in solids : characteristics energy-loss experiments, Optical properties of solids, Optical studies of solids
- **Electron-Phonon Interaction in Metals** (10 Hours)
 Basic Hamiltonian, New features associated with the electron-phonon interaction, General physical picture, Phonon frequencies and effective electron-electron interaction, The approach to equilibrium of a coupled electron-phonon system, High-temperature conductivity, More detailed calculations of the relaxation time, Low temperature conductivity, Quasi-particle properties.
- **Nanomaterials** (10 Hours)
 Low dimensional structures and energy quantization, Plasmon band and exciton, Quantum dots, quantum wires and quantum wells. Synthesis, characterization and properties: Metallic, semiconducting, magnetic, and carbon based Nanostructures, nanocomposites, biological nanomaterials. Nanofabrication: Lithographic techniques for nanoprinting, nanomanipulation techniques, self assembly.

(Total Contact Time (Theory) : 42 Hours)

BOOKS RECOMMENDED :

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| 1. C. Kittel, | <i>Quantum Theory of Solids,</i> | John Wiley, | 1987 |
| 2. G. D. Mahan | <i>Many-Particle Physics</i> | Plenum Press | 1990 |
| 3. David Pines | <i>Elementary Excitations in Solids,</i> | Benjamin | 1964 |
| 4. W. Fetter and J. D. Walecka | <i>Quantum Theory of Many-Particle Systems</i> | McGraw-Hill, New York, | 1971 |
| 5. A. S. Edelstein and R.C.Cammarata | <i>Nanomaterials: Synthesis, properties and Applications,</i> | IOP (UK) | 1996 |