Sankalchand Patel University

Faculty of Science & Humanities

Master of Science (SEM-2) (Physics)

In Effect from Academic Year 2021-22

Subject Code:1SC2050201	**Subject Title:** Theoretical Condensed Matter Physics

COURSE OBJECTIVE:

Physics is a science to understand the nature. This course is designed to get basic understanding of the physical world.

LEARNING OUTCOMES:

- Develop an actual understanding of Condensed Matter Physics.

Teaching scheme (hours) per week		**Credit**		**University Examination**		**Internal Examination**		**Total**
Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	
4	**--**	**4**	**--**	**60**	**--**	**40**	**--**	**100**

Unit	**Content**	**Lectures**	**Weight (%)**
1	Introduction, electron moving in a one-dimensional potential well, three dimensional potentialwell, quantum state and degeneracy, the density of states, Fermi-Dirac statistics, effect of temperature on Fermi distribution function, the electronic specific heat, the electrical conductivity of metals, relaxation time and mean free path, electrical conductivity and Ohms law, Wiedemann Franz-Lorentz law, the electrical resistivity of metals, thermionic emission, the Hall effect.	15	25
2	Semiconductor Crystals: Band gap, Equations of motion, Holes, Effective mass: physical interpretation, Effective masses in semiconductors. Dielectrics: Macroscopic electric field, depolarization field, Local electric field at an atom,Lorentz field , Field of dipoles inside cavity, dielectric constant and Polarisability, electronic polarizabiltiy, classical theory of electronic polarizability, Magnetism: Langevin's diamagnetismequation, Paramagnetism–Quantum theory, Cooling by isentropic demagnetization, Nuclear demagnetization, Paramagnetic susceptibility of conduction electrons, Ferromagnetic order, Curie point and exchange integral.	15	25
3	Bloch theorem, the Kronig-Penny model, construction of Brillouin zones, symmetry properties of the energy function, extended, reduced and periodic zone schemes, effective mass of an electron, the nearly free electron model, tight binding approximation, Orthogonalized Plane Wave (OPW) method, the pseudopotential method, conductors, semiconductors and insulators.	15	25
4	Superconductivity-its occurrence and experimental survey, Meissner effect, Heat capacity,energy gap, Microwave and infrared properties, Isotope effects, Theoretical survey, Thermodynamics of superconducting transition and London equation, Coherence length, BCStheory of superconductivity, Flux quantization in a superconducting ring, Type II superconductors, single particle tunneling and Josephson superconductor tunneling, Fullerenes.	15	25

Basic Reference book:

1. Introduction to Solid State Physics by C. Kittle (John Wiley & Sons)
2. Elements of Solid State Physics by J.P. Srivastava (Prentice Hall of India)
3. Solid State Physics: Structure and Properties of Materials by M. A. Wahab (Narosa Publishers).
4. Solid State Physics (Theory, Applications and problems) by S.L.Kakani& C. Hemrajani (Sultan
5. Chand & Sons, New Delhi)
6. Principles of Solid State Physics by R. A. Levy (Academic Press)
7. Elementary Solid State Physics by M. A. Omar (Addison-Wesley Publishing Company).
8. Elements of X-ray Diffraction- B. D. Cullity