

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

## Syllabi for Ph.D Credit Courses

### Physics

#### **Subject code: 1492 MATERIAL SCIENCE FOR PHYSICISTS**

##### **UNIT-I: Dielectrics and Ferroelectrics**

Macroscopic description of the static dielectric constant, the electronic and ionic polarization of molecules, orientational polarization, measurement of dielectric constant of a solid, the internal field of Lorentz, Clausius – Mosott relation- elementary ideas on dipole relaxations.

Classification of ferroelectric crystals-BaTiO<sub>3</sub> and KDP, dielectric theory of ferroelectricity, spontaneous polarization and ferroelectric hysteresis.

##### **UNIT – 2: Magnetic properties**

Quantum theory of diamagnetism, origin of permanent magnetic moment, theories of paramagnetism, paramagnetic cooling, spontaneous magnetization, Weiss theory of spontaneous magnetization, nature and origin of the Weiss molecular field. Heisenberg exchange interaction, hysteresis. The Bloch wall, Neel's theory of antiferromagnetism. Ferromagnetism, ferrites and their applications (basic concepts only)

##### **UNIT -3: Superconductivity**

Occurrence of superconductivity, experimental observations, persistent currents. Effect of magnetic fields, Meissner effect, Type-I and Type – II superconductors, intermediate states, entropy and heat capacity, energy gap. Isotope effect, thermal conductivity. Theoretical explanations, London's equation. Penetration depth, coherence length, Cooper pairs, elements of BCS theory, Josephson tunneling, Josephson effects (basic ideas)

##### **UNIT – 4: Fiber optics and Lasers**

Introduction, ray theory, Transmission, Types of fibers, Photoconductor, fiber optic sensors. Lasers, basic concepts, condition for lasing action, ruby laser, helium-neon laser, semiconductor lasers, applications.

##### **BOOKS:**

1. Introduction to solid state physics by C.Kittel
2. Materials science by M.Arumugam
3. Materials science & Engineering by WD Callister (Jr)