COMPUTATIONAL PHYSICS **3 0 0 3**

OBJECTIVE

This course comprehends the essential physics for the computer hardware. It gives an understanding of electrical, magnetic, and superconductivity of various metals.

UNIT – I ELECTRICAL PROPERTIES OF METALS **9**

Classical theory Drude model – thermal conductivity, thermal resistance – electrical conductivity of nonmetals semiconductors, ionic crystals and glasses – thin metal films: conductivity and resistivity – Schrbdinger wave equation – particle in a box - degenerate states – Fermi-Dirac statistics – density of states: electron concentration and Fermi level – band theory of solids: energy band formation - electron effective mass.

UNIT – II SEMICONDUCTORS **9**

Intrinsic semiconductors energy band-diagram – direct and indirect band gap semiconductors – carrier concentrations and conductivity – extrinsic semiconductors n, p-type doping, compensation doping – temperature dependence of conductivity – degenerate and nondegenerate semiconductors – recombination and minority carrier injection: direct and indirect recombination – minority carrier lifetime – diffusion and conduction equations and random motion – continuity equation: time-dependent continuity equation, steady-state continuity equation – optical absorption - Hall effect and devices – Ohmic contacts – Schottky diode and solar cell.

UNIT – III DIELECTRIC MATERIALS AND INSULATION **9**

Matter polarization and relative permittivity: definition – dipole moment and polarization vector P-polarization mechanisms electronic, ionic, orientational, interfacial and total polarization – frequency dependence – local field and Clausius-Mossetti equation – dielectric constant and dielectric loss - Gauss's law and boundary conditions – dielectric strength and insulation break-down in gases, liquids and solids – capacitor materials – typical capacitor constructions – piezoelectricity, ferroelectricity and pyroelectricity – quartz oscillators and filters – piezo and pyroelectric crystals.

UNIT – IV MAGNETIC PROPERTIES AND SUPERCONDUCTIVITY **9**

Magnetic dipole moment – origin atomic magnetic moments – magnetic materials: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism, ferromagnetism – origin and the exchange interaction - saturation magnetization and Curie temperature – ferromagnetic materials magnetic domains magnetocrystalline anisotropy, domain walls and motion – M versus H behaviour, demagnetization – soft and hard magnetic materials -

examples and uses - Giant Magneto Resistance and materials – superconductivity properties and classifications - High Tc superconductors - applications

UNIT – V OPTICAL PROPERTIES OF MATERIALS 9

Light waves in a homogeneous medium - refractive index - dispersion: refractive index-wave-length behaviour - group velocity and group index - Fresnel's equations: amplitude, reflection and transmission coefficients, intensity, reflectance and transmittance - complex refractive index and light absorption - lattice absorption - Luminescence, phosphors and white LEOs - polarization - optical anisotropy uniaxial crystals, Fresnel's optical indicatrix, birefringence, dichroism - birefringent retarding plates - electro-optic effect and amplitude modulators - phase modulators - electro-optic effect in waveguide devices.

TOTAL: 45

TEXT BOOK:

1. Palanisamy, P.K., Materials Science, Scitech, 2003
2. Arumugam, M, Materials Science, Anirudha Publ., 2002.

REFERENCES:

1. Kasap, SO., Principles of Electronic Materials and Devices, Tata McGraw-Hill, 2007.
2. Ali Omar, M, Elementary Solid State Physics, Adition Wiley, 1974.
3. Kittel, C, Introduction to Solid State Physics, John Wiley, 1996.