**ELX 226.2 Electrical Engineering Materials (2 -2 0)**

| | Theory | Practical | Total |
|---|---|---|---|
| Sessional | 50 | - | 50 |
| Final | 50 | - | 50 |
| Total | 100 | - | 100 |

**Course Objectives:**

To provide a basic understanding of the electric and magnetic properties of materials used in electrical and electronics engineering.

**Course Contents:**

**1. Theory of Metals (3 hrs)**

Elementary quantum mechanical ideas, free electron theory, energy well model of a metal, density of states function, the Fermi-Dirac distribution function, thermionic emission, work function, the Fermi level at equilibrium, contact potential.

**2. Free Electron Theory of Conduction in Metals (4 hrs)**

Thermal velocity of electrons at equilibrium, lattice scattering, mean free time between collisions, drift velocity of electrons in an electric field, diffusion of electrons, diffusion coefficient, Einstiein's relationship between mobility and diffusion coefficients, chemical and physical properties of common conducting, materials such As, Au, Ag, Cu, Al, Mn, N, etc,

**3. Conduction in Liquids and Gases (2 hrs)**

Ionic conduction in electrolytes, electrical conduction in gases, are discharges, electric breakdown.

**4. Dielectric Materials (4 hrs)**

Macroscopic effects, polarization, dielectric constant, dielectric losses, frequency and temperature effects, dielectric breakdown, Ferro electricity and piezoelectricity, properties of common dielectrics such as glass, porcelain, polyethylene, PVC, nylon, bakelite, rubber, mica, transformer oil, etc.

**5. Magnetic Materials (5 hrs)**

Ferromagnetism, ferromagnetism, para magnetism, domain structure, hysteresis loop,eddy current losses, soft magnetic materials, Fe-Si alloys, Ni-Fe alloys, Ferrites for high frequency transformers, square loop materials for magnetic memory, relaxation oscillators, hared magnetic materials such as carbon steels alnico and barium farrites.

**6. Semi conducting Materials (8 hrs)**

Band structure of group iv materials, energy gap, density of states function, Femi-Dirac distribution function, hole and electron densities in an intrinsic crystal, effective densities of states, intrinsic concentration, Femi level of energy at equilibrium, group iii and group iv impurities, acceptors and donors, p-and n-type materials, energy band diagrams for uniformly-doped and graded p-and n-type materials, generation PN, recombination of electrons and holes, concept of lifetime, mobility and diffusion coefficients for electrons and holes in semiconductors, transport and continuity equations for electrons and holes, concept of diffusion length, energy band diagram for a p-n junction, contact potentials, metal-semiconductor contacts.

**7. Semiconductor Materials Procession (4hrs)**

Crystal growing, doping by solid state diffusion, ion implantation, oxidation Photolithography, the planar process, metallization, contacts.

**Reference Books:**


1. R.A. Colcaser Ands. Diehi-Nagle, *Materials and Devices* for *Electrical Engineers and Physicists,* McGraw-Hill, New York, 1985.
2. R.C. Jaeger, *Introduction to Microelectronic Fabrication-Volume* IV, Addison-Wesley Publishing Company Inc., 1988.