**Course objectives**:  
To provide a basic understanding of the different materials used in electrical and electronics engineering.

1. **Theory of Metals(8 hours)**
   1. Elementary Quantum mechanical ideas: Wave Particle Duality, Wave function, schrodinger’s equation, operator notation, expected value
   2. Infinite Potential Well: A confined electron.
   3. Finite Potential Barrier: Tunneling Phenomenon
   4. Free electron theory of metals: Electron in a linear solid, Fermi energy, Degenerate states, Number of States, Density of States, Population Density
   5. Fermi-Dirac Distribution Function
   6. Thermionic Emission: Richardson’s Equation, Schottky Effect
   7. Contact Potential: Fermi level at Equilibrium

1. **Free Electron Theory of Conduction in metal(6 hours)**
   1. Crystalline structure: Simple cubic structure, Body centered cubic, Face centered cubic
   2. Band Theory of Solids
   3. Effective mass of Electron
   4. Thermal Velocity of Electron at equilibrium
   5. Electron mobility, conductivity and resistivity

1. **Dielectric materials(6 hours)**
   1. Matter polarization and Relative permittivity: Relative permittivity, Dipole moment, Polarization vector, Local field, Clausius-Mossotti equation
   2. Types of Polarization: Electronic polarization, Ionic polarization, Orientational polarization, Interfacial polarization
   3. Dielectric losses: Frequency dependence
   4. Dielectric breakdown in solids
   5. Ferro-electricity and Piezoelectricity

1. **Magnetic Materials(6 hours)**
   1. Magnetic material classification: Diamagnetism, Paramagnetism, Ferromagnetism, Anti-ferromagnetism, Ferrimagnetism
   2. Magnetic Domains: Domain structure, Domain Wall motion, Hysteresis loop, Eddy current losses, Demagnetization
   3. Soft magnetic materials: Examples and uses
   4. Hard magnetic materials: Examples and uses

1. **Superconductivity(5 hours)**
   1. Zero Resistance and the Meissner effect
   2. Type I and Type II superconductors
   3. Critical current density

1. **Semiconductors(14 hours)**
   1. Intrinsic semiconductors: Silicon crystal, Energy band diagram, Conduction in semiconductors, Electrons and Hole concentration
   2. Extrinsic semiconductors: n-type doping, p-type doping, compensation doping
   3. Introduction to GaAs semiconductor
   4. Temperature dependence of Conductivity: Carrier concentration temperature dependence, Drift mobility temperature and Impurity dependence, Conductivity temperature dependence, Degenerate and non-degenerate semiconductors
   5. Diffusion on semiconductor: Einstein's Relationship
   6. Direct and indirect generation and recombination
   7. Pn junction: Forward biased, reverse biased pn-junction.

**References:**

1. Bhadra Prasad Pokharel and Nava Raj Karki,"Electrical Engineering Materials",Sigma offset Press,Kamaladi, Kathmandu, Nepal,2004.
2. R.C. Jaeger,”Introduction to Microelectronic Fabrication- Volume IV”, Addison Wesley publishing Company,Inc., 1988.
3. Kasap.S.O, Principles of electrical engineering materials and devices, McGraw Hill, NewYork,2000.
4. R.A.Colcaser and S.Diehl-Nagle,”Materials and Devices for Electrical Engineers and Physicists,McGraw-Hill, New York, 1985.

**Evaluation Scheme:**  
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Chapters** | **Hours** | **Marks distribution\*** | **Theory** | **Numerical** |
| 1 | 8 | 12 | 8 | 4 |
| 2 | 6 | 10 | 6 | 4 |
| 3 | 6 | 10 | 10 | X |
| 4 | 6 | 10 | 10 | X |
| 5 | 5 | 8 | 8 | X |
| 6 | 14 | 30 | 18 | 12 |
| Total | 45 | 80 | 60 | 20 |

**\*Note: There may be a minor deviation in marks distribution**