Course Name	Physics II
Course Code	PH(EE)401
Course Credit	4
Contact Hour	3L-1T
Prerequisite	

Course Objective

The course objectives are:

1. Narrate the scientific details of various electronic &optical devices.
2. explain the electronic transport phenomenon inside metal, insulator, semiconductors and related areas of applications.
3. develop knowledge of underlying physics behind the magnetic and super conducting materials and their potential use in modern technology.
4. apply various semiconducting devices for device operations such as sensor, detector, actuators.
5. apply quantum mechanics and solid state physics to study organic semiconductors & nanomaterials related areas of applications.

Course Outcome

On completion of the course students will be able to

1. Apply the knowledge of
   - Schrödinger equation in problems of junction diode, tunnel diode
   - Band theory explain electrical conductivity of metal, insulators and semiconductor
   - Magnetism and semiconductor physics in data storage
   - Organic Semiconductors and nanomaterials
2. Analyze
   - The need of suitable theoretical methods to explain electron transport in all types of material
   - Wide spread use of semiconductor devices
   - Physics of storage devices
   - Role of organic semiconductors over existing semiconductor devices
3. Design and realize
   - Physics of insulators and probable areas of application
   - Storage devices using magnetic material, semiconductor devices.
   - Simple but small systems with novel physical properties
4. Conduct experiments using
   - Band theory and electron transport in a semiconductor
   - Intrinsic semiconductor under electric and magnetic field
   - Temperature sensor, thermoelectric sensor
   - Semiconductor Photovoltaic cell, Light emitting diodes, Light dependent resistor
   - Cathode ray oscilloscope
   - Various types of magnetic materials
5. Communicate effectively, write reports and make effective presentation using available technology
   - on topics allied to the subject particularly in areas of applications shared in student seminar
6. Engage in independent self-study to formulate, design, enhance, demonstrate
   - New elements with novel physical properties
   - Correct model of electron transport in organic systmes

CO Mapping with departmental POs

H: High, M: Medium, L: Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	√											
CO 2		√										
CO 3			√									
CO 4	√	√	√	√					√	√		
CO 5		√								√		
CO6		√	√	√					√	√		√

Course Content:

Module I: Quantum mechanics

Generalized co-ordinates, Lagrange's equation of motion and Lagrangian, generalized force potential, moment and energy. Hamilton's Equation of motion and Hamiltonian. Properties of Hamilton and Hamilton's equation of motion. **6L**

Concept of probability and probability density, operator, Commutator, Formulation of quantum mechanics and Basic postulates, Operator correspondence, Time dependent Schrodinger's equation, formulation of time independent Schrodinger's equation by method of separation of variables, Physical interpretation of wave function Ψ (normalization and probability interpretation), Expectation values, Application of Schrodinger equation-Particle in an infinite square well potential (1-D and 3-D potential well), Discussion on degenerate levels. **10L**

Module II: Statistical Mechanics

Concept of energy levels and energy states. Microstates, Macrostates and thermodynamic probability, equilibrium macrostate. MB, FD, BE statistics (no deduction necessary), fermions, bosons (definitions in terms of spin, examples), physical significance and application, classical limits of quantum statistics. Fermi distribution at zero and non –zero temperature. **4L**

Module III: Dielectric Properties:

Dielectric Material: Concept of Polarization, the relation between D, E and P, Polarizability, Electronic, Ionic, Orientation & Space charge polarization, behavior of Dielectric under alternating field, Dielectric losses. **3L**

The Magnetic properties:

Magnetization M, relation between B, H & M. Bohr megneton, Diamagnetism-Larmor frequency & susceptibility, Curie law, Weiss molecular field theory & Curie-Weiss law, Hysteresis loss, Antiferromagnetism, Ferromagnetism & Ferrites (analitative). **4L**

Module IV: Crystal Structure

Crystal structure- Bravais lattice, Miller indices; Crystal diffraction (qualitative), Bragg's law

and reciprocal lattice,Brillouin zone.(Qualitative description); Free electron theory of metal – calculation of Fermi energy, density of states; Band theory of solids- Bloch theorem, Kronig Penny model; Electronic conduction in solids-Drude's theory, Boltzmann equation, Wiedemann Frantz law; Semiconductor-Band structure, concept of electron and holes, Fermi level, density of States. **14L**

Text Books

1. Perspectives of Modern Physics: A. Baiser
2. Modern Physics and Quantum Mechanics E.E. Anderson
3. Refresher course in B.Sc. Physics (Vol. III): C.L. Arora
4. Fundamentlas of Physics (Vol. III): Haliday, Resnick & Krane
5. Engineering Physics: R.K. Kar
6. Classical Mechanics:
   a) A.K. Roychaudhuri
   b) R.G. Takwal & P.S. Puranic
7. Quantum Mechanics:

a) Eisberg & Resnic
b) A.K. Ghatak & S. Lokanathan
c) S.N. Ghoshal

7. Statistical Mechanics and Thermal Physics:
   a) Sears and Salinger
   b) Avijit Lahiri c) Evelyn Guha

8. Solid Sate Physics:
   a) A.J. Dekker
   b) C. Kittel
   c) Aschroft & Mermin d) S.O. Pillai