PH-9201 **Condensed Matter Physics-II**

L	T	P	C
4	1	0	5

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Explain the behaviour of electrons in solids based on classical and quantum theories.

CO2: Understand the classification of solids using Bloch's theorem & band theory and know the fundamental principles of semiconductors.

CO3: Demonstrate various types of vacuum pumps and gauges and can design a vacuum system

CO4: Demonstrate the different stages of thin film formation and know various techniques for preparation of thin films.

CO5: Classify material as 0D, 1D, 2D and 3D on the basis of density of states and correlate the physical properties with physical dimensions.

CO6: Understand processing techniques for nanomaterials and different methods for its characterization and application.

CO/PO Mapping

S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	W	W	W	W	W	W	S	M	S	S	W	M
CO2	W	S	S	M	M	W	M	W	M	W	M	S
CO3	S	W	S	M	W	S	S	S	S	W	S	S
CO4	S	M	M	M	S	S	M	W	M	M	M	W
CO5	S	S	S	W	S	S	M	M	W	M	W	M
CO6	S	W	S	S	S	W	S	W	W	S	W	M

L	T	P	C
4	1	0	5

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UNIT I

Electronic Properties of Solids and Energy Bands: Quantum theory of free electron, Fermi energy and density of free electron states, electron in periodic lattice, Bloch theorem, Kronig-Penny model and band theory, Brillouin zones, effective mass, classification of solids on the basis of band theory, Semiconductors, Intrinsic carrier concentration, Donors and Acceptors, Direct and Indirect band semiconductors: Electronic band structures in solids- Nearly free electron theory, Tight binding method-application to a simple cubic lattice and band structure in copper, Fermi surface: construction of Fermi surface in two- dimension, Quantisation of orbits in a magnetic field, cyclotron resonance- de Hass van alfen effect, Normal Hall effect and elementary ideas of quantum Hall effect. **20Hrs**

Vacuum technology: Basic ideas about vacuum, throughput, conductance, Vacuum pumps: rotary pump, diffusion pump, ion pump, molecular pump, cryopump, vacuum gauges: pirani gauge, penning gauge and ionisation (hot cathode and cold cathode Ionisation) gauges. **10Hrs**

UNIT II

Thin films: Thin film and growth process, Thins Film Deposition Techniques: Physical vapour deposition: thermal evaporation, sputtering, laser ablation and pulsed laser, chemical vapour deposition, spray pyrolysis, Thin film thickness measurement techniques: film resistance method, optical method and microbalance method. **15Hrs**

Nano Structural Materials and its Characterization: Definition and properties of nanostructured materials. Methods of synthesis of nanostructured materials, experimental techniques for characterization nanostructure materials (electron microscopy, Transmission electron microscopy, scanning electron microscopy, Auger electron microscopy, atomic force microscopy, Energy-dispersive X-ray spectroscopy), New forms of carbon – fullerenes, nanowires and nanotubes. **15Hrs**

Total: 60Hrs

BOOKS:

1. Solid State Physics by C. Kittel
2. Quantum theory of Solids - Charles Kittel
3. M. Ali Omar: Elementary solid state physics (Addison-wesley)
4. Multiple beam interferrometry by Tolansky
5. Vacuum science and Technology by V.V.Rao, T.B.Ghosh and K.L.Chopra
6. Physics of Thin Films by K. L. Chopra
7. Principles of Condensed Mater Physics by P.M. Chaikin and T.C. Lubensky.
8. Solid State Physics: N.W. Ashcroft and N.D. Mermin
9. Handbook of Nanotechnology by Bharat Bhushan.
10. Handbook of Nanostructured Materials and Nanotechnology (Vol. 1 to 4). Ed. Hari Singh Nalwa

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