PH8252	PHYSICS FOR INFORMATION SCIENCE	L	Т	Ρ	С
	(Common to CSE & IT)	3	0	0	3

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OBJECTIVES:

 To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic and optical properties of materials and Nano-electronic devices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole.

UNIT II SEMICONDUCTOR PHYSICS

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor: random motion, drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

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UNIT III MAGNETIC PROPERTIES OF MATERIALS

Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility - Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferromagnetism – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-– Magnetic principle in computer data storage – Magnetic hard disc (GMR sensor).

UNIT IV OPTICAL PROPERTIES OF MATERIALS

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode – solar cell - LED – Organic LED – Laser diodes – Optical data storage techniques.

UNIT V NANO DEVICES

Electron density in bulk material – Size dependence of Fermi energy – Quantum confinement – Quantum structures – Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials – Tunneling: single electron phenomena and single electron transistor – Quantum dot laser. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance – Carbon nanotubes: Properties and applications .

OUTCOMES:

At the end of the course, the students will able to

- Gain knowledge on classical and quantum electron theories, and energy band structuues,
- Acquire knowledge on basics of semiconductor physics and its applications in various devices,
- Get knowledge on magnetic properties of materials and their applications in data storage,
- Have the necessary understanding on the functioning of optical materials for optoelectronics,
- Understand the basics of quantum structures and their applications in carbon electronics...

TEXT BOOKS:

- 1. Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley 2012.
- 2. Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.
- 3. Kittel, C. "Introduction to Solid State Physics". Wiley, 2005.

REFERENCES

- 1. Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.
- 2. Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education, 2009.
- 3. Rogers, B., Adams, J. & Pennathur, S. "Nanotechnology: Understanding Small Systems". CRC Press, 2014.

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TOTAL :45 PERIODS