VELAMMAL COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI

DEPARTMENT OF PHYSICS

SEMESTER - II

21PH103	PHYSICS FOR INFORMATION SCIENCE (Applicable to Computer Branch Students (CSE & IT))	L	T	P	C
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OBJECTIVES:

- To make the students understand the importance in studying electrical properties of materials.
- To enable the students to gain knowledge in semiconductor physics.
- To instill knowledge on magnetic properties of materials.
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.
- To inculcate an idea of significance of nano structures, quantum confinement, ensuing nano device applications and quantum computing.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9

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 effective mass - Concept of hole.

UNIT II	SEMICONDUCTOR PHYSICS	9

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.

UNIT III	MAGNETIC PROPERTIES OF MATERIALS	9

Magnetic dipole moment - Atomic magnetic moments - Magnetic permeability and susceptibility - Magnetic material classification: diamagnetism - Paramagnetism - Ferromagnetism - Antiferromagnetism - Ferrimagnetism - 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	9

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	NANODEVICES AND QUANTUM COMPUTING	9

Introduction - Quantum confinement - Quantum structures: quantum wells, wires and dots - Band gap of nanomaterials. Tunneling - Single electron phenomena: Coulomb blockade - Resonant- tunneling diode - single electron transistor - quantum cellular automata - Quantum system for information processing - quantum states - classical bits - quantum bits or qubits - CNOT gate - multiple qubits - quantum gates - advantage of quantum computing over classical computing (qualitative).

	TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

CO1: Gain knowledge on classical and quantum electron theories, and energy band structures. (K2)

CO2: Acquire knowledge on basics of semiconductor physics and its applications in various devices. (K2)

CO3: Get knowledge on magnetic properties of materials and their applications in data storage. (K2)

CO4: Have the necessary understanding on the functioning of optical materials for optoelectronics (K2)

CO5: Understand the basics of quantum structures and their applications and basics of quantum computing. (K2)

TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices Basic Principles", Wiley (Indian Edition), 2007.
2. S.O. Kasap, Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition), 2020.
3. Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020.

REFERENCES

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
2. Y.B.Band and Y.Avishai, Quantum Mechanics with Applications to Nanotechnology and Information Science, Academic Press, 2013.
3. V.V.Mitin, V.A. Kochelap and M.A.Stroscio, Introduction to Nanoelectronics, Cambridge Univ.Press, 2008.
4. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition) 2009.
5. B.Rogers, J.Adams and S.Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014.

WEB REFERENCE

1. https://onlinecourses.nptel.ac.in/noc20_mm17/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee59/preview
3. https://onlinecourses.nptel.ac.in/noc21_ee59/preview