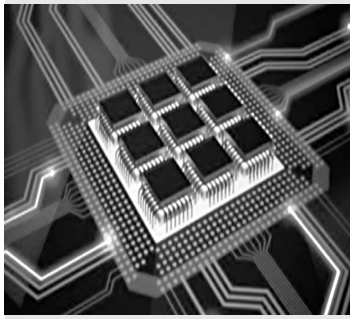
21HS151 PHYSICS FOR ELECTRONIC ENGINEERS

Hours Per Week :

L	T	P	C
2	-	2	3

Total Hours :

L	T	P
30	-	30



SOURCE:
https://www.deccan chronicle.com/technology/in-other-news/241017/scientists-invent-new-semiconductor-capable-of-doing-optical-communication.html

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed at imparting knowledge on Crystal physics, principles of Quantum Mechanics and Electron theory of metals. This course throws light on semiconductor physics and Optoelectronic devices along with photonics. Further it highlights the principles and concepts of electrical properties in the perspective of Engineering.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1	Compare the crystal geometry in terms of lattice parameters and crystal planes.
2	Apply the principles of quantum mechanics to learn the dynamics of free electrons in metal.
3	Classify the extrinsic semiconductors using Hall effect and compute carrier concentration in semiconductors to understand transport mechanism in semiconductors.
4	Evaluate electron dynamics in the presence of electric and magnetic fields.
5	Predict the importance of photonic devices relevant to engineering domains.

SKILLS:

- ✓ *Analyze crystal structures.*
- ✓ *Compute the crystal geometry in terms of crystal planes and defects.*
- ✓ *Compute carrier concentration in semiconductors and hence conductivity.*
- ✓ *Analyze band structure and classify materials based on band structure and calculate band gap for semiconductors.*
- ✓ *Compute electric and magnetic field in materials based on fundamental principles.*
- ✓ *Calculate photoconductivity, responsivity and sensitivity of various photo conducting materials such as photodiodes and photo resistors.*
- ✓ *Calculate the efficiency and fill factor of solar cell.*

UNIT - I **L-6**

INTRODUCTION TO SOLIDS:

Bonding in Solids (Types); Crystalline and amorphous solids; Lattice points and space lattice, Basis, Crystal structure, Unit cell, Primitive cell and l attice parameters; Crystal systems and Bravais lattices; Packing factor for SC, BCC and FCC; Miller indices, Distance of separation between successive (h k l) planes; X-ray diffraction, Bragg's law, Powder crystal method; Classification of defects, Point defects.

UNIT - II **L-7**

QUANTUM MECHANICS:

Introduction to quantum mechanics-wave and particle duality of radiation, deBroglie's concept of matter waves, Electron diffraction; Heisenberg's uncertainty principle; Schrodinger's time independent wave equation, Eigen values and Eigen functions of a particle confined to one dimensional infinite square well (potential well).

FREE ELECTRON THEORY OF METALS:

Classical and Quantum free electron theory of metals, Fermi-Dirac distribution, Density of states. Bloch's theorem (Qualitative), Kronig - Penny Model (Qualitative), Classification of solids based on energy bands.

UNIT - III **L-6**

SEMICONDUCTOR PHYSICS:

Introduction, Classification of semiconductors, Direct and indirect band gap semiconductors, Intrinsic semiconductors; Variation of intrinsic carrier concentration with temperature, Fermi level and conductivity; Extrinsic semiconductor, Effect of temperature on carrier concentration in extrinsic semiconductors, Band diagrams of extrinsic semi conductors; Hall effect.

UNIT - IV **L-6**

ELECTROMAGNETICS:

Electrostatics : Vector analysis; Computation of electric field and potential in specific cases, Electric flux density, Divergence, Gauss law, Differential form of Gauss law, Derivation of Coulomb's law from Gauss law, Applications of Gauss law, Electric displacement vector; Applications of Maxwell's equations.

Magnetostatics: Gauss law of for magnetism, Biot-Savart's law, Ampere's law, Faraday's law of induction in integral form; Lenz's law, Maxwell's equations in integral form.

UNIT - V **L-5**

OPTOELECTRONICS: Introduction-Classification of optoelectronic devices; PN Junction diode, Photo detectors, PIN and Avalanche photo diodes, Photo voltaic cell, LED, Semiconductor diode laser.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS — TOTAL HOURS:30

1. Laser - Determination of wavelength.
2. Optical fibre – Determination of Numerical aperture – Acceptance angle.
3. Determination of Planck's constant.
4. Melde's Experiment - determination of the frequency of tuning fork.
5. Determination of wavelength of given light source using diffraction grating method.
6. Determination of resistivity of metal using 2 probe / 4 probe method.
7. Determination of Energy Band gap of p-n junction diode.
8. Hall Effect - Determination of Hall coefficient.
9. Stewart & Gee's Experiment- Study of magnetic field along the axis of a current carrying coil.
10. Verification of Tangent law.
11. Solar cell – Determination of Fill factor & efficiency.
12. LED - Study of V-I characteristics.

TEXT BOOKS:

1. S.O.Pillai, "Solid State Physics", 8th edition, New Age International Publishers, 2018.
2. H. P. Myers, "Introduction to Solid State Physics", Taylor & Francis, 2009.

REFERENCE BOOKS:

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", 6th edition, John Wiley and Sons, 2001.
2. Charles Kittel, "Introduction to Solid State Physics", 7th edition, Wiley, 2007.
3. Donald A. Neamen, "Semiconductor Physics and Devices:Basic Principle", 4th edition, Mc Graw-Hill, 2012.
4. David J. Griffiths, "Introduction to Electrodynamics", 3rd edition, Prentice Hall of India, 2012.
5. Neil W. Ashcroft and David Mermin, "Solid State Physics", International Student Edition, Holt, Rinehort & Winston Publishers, 2008.

LABORATORY MANUALS:

1. Dr.Ruby Das, C.S.Robinson, Rajesh Kumar and Prasanth Kumar "A text book of Engineering Physics Practical", 1st edition, Sahu University Science Press, 2010.
2. Jayaraman, "Engineering Physics Laboratory Manual", 1st edition, Pearson Education, 2014.

ACTIVITIES :

- *Construction of various crystal models.*
- *Identification of crystal structure from XRD pattern.*
- *Determination of Hall coefficient.*
- *Laser- Measurement of height of the building.*
- *Finding out the grating constant by known wave length of laser.*
- *Frequency of laser by using diffraction grating.*
- *Determination of efficiency of solar cell when two solar cells are connected in parallel and in series.*