# 20SH1102 - APPLIED PHYSICS

(Common to EEE, CSE, IT and AI&DS)

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| **Course Category:** | Basic Science | **Credits:** | 3 |
| **Course Type:** | Theory | **Lecture - Tutorial - Practical:** | 2-1-0 |
| **Prerequisite:** | Fundamental concepts of Physics | **Sessional Evaluation:****Univ. Exam Evaluation:****Total Marks:** | 4060100 |
| **Objectives** | Students undergoing this course are expected to* To understand various phenomena exhibited by light and describe the characteristics, construction & working of lasers along with applications in Science & Technology.
* To acquire knowledge of crystal systems & their analysis using X-rays and concepts of ultrasonics.
* Apply principles of quantum mechanics to various atomic phenomena and understand the electrical behaviour of solids.
* Explain and provide the knowledge about semiconductors and their use in electronic devices.
* Basic properties of dielectric &magnetic materials and their uses in Science & Technology.
* Understand the behaviour of superconductors, nano materials, quantum phenomena and the limitations of basic physical laws.
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| **Course Outcomes** | Upon successful completion of this course students will be able to: |
| CO1 | Understand the utilization of laser technology in various disciplines. |
| CO2 | Understand the structure of crystalline solids and their applications in x-ray diffraction. |
| CO3 | Able to understand the basic concepts of quantum physics applicable to solids. |
| CO4 | To know the properties of semiconductor materials by projecting the view of energy bands. |
| CO5 | Understand the concepts of polarization& magnetization and also applications of dielectric& magnetic materials in various disciplines. |
| CO6 | Basic ideas about superconductors and nano materials with their uses in various fields of Science & Technology. |
| **Course Content** | UNIT - IWave optics & Lasers **Wave optics**: Introduction (Interference of light) - Interference of light by wave front splitting (Young’s double slit experiment) and amplitude splitting (Newton rings) – Fraunhoffer diffraction from a single slit, double slit - Diffraction grating (qualitative).**Lasers**: Spontaneous & stimulated emission of radiation - Population inversion– Properties of lasers (monochromacity, coherence, directionality, brightness) – Types of lasers: solid state (Nd-YAG), gas (He–Ne) – Applications of lasers in science, engineering & medicine.UNIT - IICrystallography, X-ray diffraction &Ultrasonics**Crystallography**: Introduction – Space lattice – Unit cell – Lattice parameters – Bravais lattice – Crystal systems – Packing fractions of S.C., B.C.C., F.C.C. – Planes in a crystal: Miller indices – Inter planar spacing in cubic crystals – Bragg’s law of diffraction – X-ray diffraction techniques: Laue method – Powder method (Debye – Scherrer method).**Ultrasonics**: Introduction - Properties and detection - Production of ultrasonics using Piezo electric method-Applications of ultrasonics.UNIT - IIIIntroduction to quantum mechanics &Electron theory**Introduction to quantum mechanics**: Wave nature of particles (de-Broglie hypothesis) – Uncertainty principle – Schrodinger time independent wave equation - Significance of wave function (Born interpretation) – Solution of stationary state Schrodinger equation for one dimensional problems (particle in a box).**Free electron theory:** Introduction (classical & quantum: postulates, success& drawbacks) – Fermi–Dirac distribution function and its temperature dependence – Fermi level – Density of states (qualitative) – Kronig–Penny model (non mathematical treatment) - Origin of energy bands– Classification into conductors, semiconductors & insulators.UNIT - IVSemiconductor physics & Semiconductor devices**Semiconductor physics**: Intrinsic Semiconductors – Intrinsic conductivity – P&N type semiconductors - Variation of Fermi level with temperature– Drift & diffusion –Einstein relation – Hall effect and its applications. **Semiconductor devices:** Formation of P-N junction – V-I Characteristics of P-N junction diode (forward & reverse bias)– Direct & indirect bandgap semiconductors – Light emitting diodes, photo detectors & solar cells (construction, working, materials & applications)UNIT - VDielectric & Magnetic properties **Dielectric properties**: Basic definitions – Electronic, ionic and orientation polarizations (qualitative) – Internal field in solid dielectrics – Clausius–Mossotti equation – Ferroelectricity – Applications of dielectrics.**Magnetic properties:** Introduction and basic definitions (B, M, H & χ) – Origin of magnetic moment – Classification of magnetic materials into dia, para, ferro, anti-ferro & ferri magnetics –Hysteresis – Soft & hard magnetic materials – Applications of magnetic materials.UNIT - VI Superconductors and Nanomaterials**Superconductors:** Introduction – Effect of temperature and magnetic field – Meissner effect – Types of superconductors (type I & II) – BCS theory –DC & AC Josephson effects (qualitative) – Applications of superconductors**Nanomaterials:** Introduction – Significance of nanoscale – Types of nanomaterials – Properties of nanomaterials: physical, mechanical, magnetic and optical – Synthesis of nanomaterials: top down-Ball milling, bottom up – Chemical vapour deposition – Applications of nanomaterials. |
| **Text Books and References** | Text Books:1. Engineering Physics by P. K. Palanisamy, Scitech Publications (2nd edition).
2. Engineering Physics by S. Maninaidu, Pearson (2009).
3. Applied Physics by K. Thyagarajan, McGraw Hill (2019).
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| Reference Books:1. Solid State Physics, by C. Kittel, Wiley India PVT Limited (2007)
2. Solid State Physics by S.O. Pillai, New Age International Publishers (2018).
3. Engineering Physics by R. K. Gaur and S.L. Gupta, Dhanpatrai Publications (2012)
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