# SILVER OAK UNIVERSITY

## Silver Oak Institute of Science

**Bachelor of Science Physics**
**Course Name: Fundamental Physics-III**
**Course Code: 2050253201**
**Semester: 3rd**

**Prerequisite:**

1. Foundational understanding of introductory physics, including mechanics, electromagnetism, and optics.

**Course Objectives:**

1. Master crystallographic fundamentals such as crystal structures, symmetry operations, and lattice classifications for crystalline materials.
2. Proficiency in reciprocal lattice and crystal diffraction with Bragg's Law, X-ray interpretation, lattice construction, and experimental techniques.
3. Comprehensive understanding of modern physics topics quantum theory origins, wave-particle duality, and key experiments like photoelectric effect and Frank-Hertz experiment.

**Teaching Scheme:**

| Teaching Scheme | | | | |
|---|---|---|---|---|
| L | T | P | Contact Hours | Credit |
| 2 | 0 | 4 | 6 | 4 |

**Contents:**

| Unit | Topics | Teaching Hours | % Weightage |
|---|---|---|---|
| 1 | **The crystalline State**<br>Crystalline, polycrystalline and glassy materials; Basis of crystal structure; Unit cell-Primitive cell structures; Symmetry operations- translation, point, hybrid operations; Classification of Crystal types-two dimensional crystal lattice and three dimensional crystal lattices; Indices of a lattice direction and a lattice plane (Miller indices); Crystal point groups and space groups, space groups, space groups; Common crystal structures, simple cubic structure, BCC, FCC, closed packed and hexagonal close-packed structure, diamond structure.<br>**Reciprocal lattice and Crystal Diffraction**<br>Reciprocal lattice; Bragg Law, Laue's interpretation of X-ray diffraction by crystals, Construction of reciprocal lattice, Relationship between a, b, c and a*, b*, c*, Experimental Diffraction Methods, Laue method, Rotating crystal method, powder method, Determination of lattice constants; Selection of incident beam.. | 14 | 50 |
| 2 | **Modern Physics**<br>Historical origins of quantum theory, Difficulties with Classical: models, optical spectra Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Gerner | 14 | 50 |

| | | | |
|---|---|---|---|
| | experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two Slit experiment with electrons. Frank- Hertz experiment, Stationary states of atoms.<br>**Motion in a Central force field**<br>General features of the motion, Motion in an inverse square law force field, Equation of the orbit, Kepler's laws of planetary motion Collision of particles : Elastic & inelastic scattering, Elastic Scattering : Laboratory & Centre of mass system, Kinematics of elastic scattering in the laboratory system, inelastic scattering, cross-section, The Rutherford formula | | |

**Course Outcomes:**

| Sr. No. | CO Statement | Unit |
|---|---|---|
| **CO-1** | Differentiate crystalline, polycrystalline, and glassy materials and classify crystal types. | 1 |
| **CO-2** | Apply Bragg's Law and Laue's interpretation for crystal diffraction. | 1 |
| **CO-3** | Analyze quantum theory origins and modern physics concepts. | 2 |
| **CO-4** | Evaluate motion in a central force field and dynamics of collisions. | 2 |

**Teaching & Learning Methodology:**

1. Conceptual Learning
2. Cooperative based Learning
3. Competency based Learning
4. Problem - based Learning

**List of Experiments:** **Total Hours: 56**

| Sr. No. | Practical Name |
|---|---|
| 1 | Y-by Koenig's method |
| 2 | Numerical Study of Oscillatory Motion. |
| 3 | Flatness of plate by Newton's ring. |
| 4 | Absorption coefficient of liquid using photocell. |
| 5 | Thermocouple |
| 6 | L by Maxwell's bridge. |
| 7 | Liquid Lens |

**Books Recommended:-**


1. S.O. Pillai, "Solid State Physics", New Age International Publishers
2. S.L Kakani & C. Hemrajani, "Solid State Physics", Sultan Chand & Sons
3. C. Kittle, "Introduction to Solid State Physics", Wiley
4. Powel and Crasemann, "Quantum Mechanics", Addison and Wesley.
5. Arthur Beiser, "Concept of Modern Physics", Tata McGraw Hill Edition
6. A.K. Saxena, "Principles of Modern Physics", Narosa Publishing House
7. Kenneth Krane, "Modern Physics", Jon Wiley & Sons


**List of Open-Source Software/learning website:**

1. http://silveroakuni.ac.in/video-lecture

**CO-PO-PSO Matrix:**

| CO. No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO-2** | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO-3** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO-4** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 |