Course Title: Photovoltaic Materials
Course Code: PHYS 421
Level: B.Sc. (Applied Physics)
Year: IV
Semester: II

Course Objectives: The main objectives of course are to help the students understand the basic physics of solar cells and acquire the knowledge of quality and performance of photovoltaic devices. The course will also help them to explore the ways to improve the efficiency of solar cell. In this course students will study form the basic to the advanced study of semiconductor and its applications in the P-N junction as the solar cell. Students will also study about solar cell parameter like solar cell characteristics, effect of solar radiation and effect of temperature in efficiency along with solar cell technologies.

1. **Introduction to Photovoltaics**: World energy requirement, need for sustainable energy resource, solar energy advantages and conversion challenges, solar cell technologies- wafer based silicon solar cells, thin film amorphous silicon, thin film CdTe and CIGS solar cells, thin film crystalline silicon solar cell technologies, cost of PV modules. [6 Hrs.]

2. **Semiconductors**: Metals, semiconductors and insulators, semiconductors as solar cell materials, energy bands in semiconductors, direct and indirect bandgap, electrons and holes, intrinsic and extrinsic semiconductors, the carrier distribution function, electron and hole concentration, temperature dependence of carriers, carrier motion in semiconductors- drift and diffusion, generation and recombination of carriers. [10 Hrs.]

3. **P-N Junctions as Solar Cells**: Introduction to P-N junction at equilibrium, energy band of P-N junction, band bending, P-N junction potential, P-N junction in non-equilibrium condition, P-N junction under illumination, generation of photovoltage, light generated current, metal- semiconductor junctions. [8 Hrs.]


5. **Design of Solar Cells**: Design for high short circuit, choice of junction depth and orientation, minimizing optical losses and recombination, design for high open circuit voltage, design for high fill factor, quantum efficiency measurements. [8 Hrs.]

6. **Emerging Solar Cell Technologies**: Organic solar cells- material properties, dye sensitized solar cells, GaAs solar cells, approaches to overcome single junction efficiency limit- crystalline multijunction solar cells, intermediate band gap, impurity PV and quantum well solar cells, hot carrier solar cells, spectrum modification approaches. [8 Hrs.]

**Textbook**

**References**