COURSE DETAILS

Course Code: B29SS
Full Course Title: Solid State Physics
SCQF Level: 9
SCAF Credits: 15
Available as Elective: Yes

DELIVERY LEVEL

Undergraduate: Yes  Postgraduate Taught: No  Postgraduate Research: No
Additional Information:

COURSE AIMS

This module aims to:

- Provide an introduction to solid state physics.
- Develop connections between solid state physics and other introductory parts of the course.
- Provide a foundation for subsequent modules (e.g. year four modules: quantum theory and solid state B20QS, semiconductor optoelectronics, B20SO).
- Develop the skills and techniques to solve problems relating to Solid State physics.

LEARNING OUTCOMES – SUBJECT MASTERY

On completion of this course the student should be able to:

- understand basic principles of crystallography
- understand basic electronic properties of metals and semiconductors
- apply this knowledge to the understanding of simple solid state devices

LEARNING OUTCOMES – PERSONAL ABILITIES

This module aims to develop the students abilities in a number of ways:

- Develop the ability to critically analyse a problem or situation;
- Applying knowledge and understanding of topics in a problem-solving context;
- Develop the ability to work with numerical and graphical problems;
- Develop an awareness, and ability, of time management.

This module aims to develop a general awareness of the significance of solid state physics:
• An interest in current developments in, and applications of, physics (e.g. in semiconductor circuits);
• A willingness to make critical and evaluative comment;
• An acceptance that physics is a changing subject.

SYLLABUS

Crystal Structures

• Periodicity and lattices
• Structure of crystals (unit cells, close packed structures, directions and planes, miller indices, Bravais lattices)
• Simple X-ray diffraction, reciprocal space
• Defects and dislocations in crystals
• Elasticity and thermal expansion
• Bonding in Crystals (van der Waals, Ionic, Covalent, Metallic)
• Tight binding model
• Crystal structure, band structure, effective mass, donors and acceptors.
• Brillouin Zones

Vibrations in Crystals

• Lattice vibrations (phonons), thermal properties, Debye specific heat
• Cyclotron resonance.

Electronic Properties of metals

• Free electron theory of metals, density of states, Fermi-Dirac distribution, electronic specific heat
• Drude model for conductivity
• Phonons in solids – ball & spring model diatomic chains.

Band Theory and Semiconductors

• Semiconductors and energy bands – Brillouin zones, energy bands, Fermi level
• Electrical and optical behaviour of semiconductors – energy gap, optical absorption, doping, Hall effect
• Doping & pn junctions
• Fundamental optical absorption, exciton absorption, recombination processes, luminescence
• Solid state devices (qualitative models of p-n junction, light emitting diode, field effect transistor)
• Semiconductors: applications in photonics as light sources (LEDs, lasers) and detectors

COURSE RELATIONSHIPS

N/A
## LOCATION AND ASSESSMENT METHODS

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