Module Code - Title:
PH4607 - SOLID STATE PHYSICS 1

Hours Per Week

Lecture	*Lab*	*Tutorial*	*Other*	*Private*	*Credits*
2	0	1	0	7	6

Grading Type:
N

Prerequisite Modules:
Quantum Mechanics

Rationale and Purpose of the Module:
The purpose of this module is to enhance the students' understanding of key concepts in solid state physics and the quantum theory of solids.

Syllabus:
Crystal dynamics: sound waves, the one dimensional crystal, normal modes, lattice vibrations and phonons, Bloch waves. Semiconductors: electrons and holes, intrinsic and extrinsic behaviour, Fermi energy, band structure, effective mass, excitons and plasmonics. Transport properties and electrodynamics of metals: conductivity, Hall effect, cyclotron resonance, Debye model of specific heat. Dielectric properties: Drude model, polarons and hopping conduction. Non-equilibrium carrier densities: continuity equations, neutrality. Photonic devices: photodiodes, LEDs, homojunction and heterojunction LASERs, photonic crystals. Optical Properties: Brillouin scattering, crystal optics, infrared absorption, optical phonons, Raman scattering.

Learning Outcomes:

Cognitive (Knowledge, Understanding, Application, Analysis, Evaluation, Synthesis)

* Show how vibrational (phonon) and recombinatorial (photon) spectra arise and how they are used to understand the structure of solids.
* Discuss the physical processes responsible for specific heat capacity of solids, light emission from semiconductors, electron transport in solids and to be able to understand and extrapolate information from associated spectroscopic techniques that identify each phenomenon.
* Describe physical basis and experimental observation of lattice vibrations in solids, band structure of semiconductors and the operation of photonic devices from fundamental phenomena.
* Derive relevant equations describing crystal dynamics, semiconducting properties,

conduction mechanisms, electrodynamics and transport processes, from basic laws and principles.
* Solve numerical problems, form information provided, on the topics covered.

Affective (Attitudes and Values)

* Discuss the importance of solid state physics and the quantum theory of solids for application in academic and research environments.

Psychomotor (Physical Skills)

N/A

How the Module will be Taught and what will be the Learning Experiences of the Students:
Students will learn via interactive lecture, experiential tutorial and problem based private study.

Research Findings incorporated in to the Syllabus (If Relevant):

Prime Texts:
O'Reilly, E. P. (2002) *Quantum Theory of Solids*, Taylor and Francis
Hook. J. R. and Hall, H. E. (1991) *Solid State Physics, (2nd edition)*, Wiley

Other Texts:
Rudden, M. N. and Wilson, J. (1993) *Elements of Solid State Physics*, Wiley
Kittel, C. (1986) *Introduction to Solid State Physics*, Wiley

Programmes

Semester - Year to be First Offered:
Autumn - 09/10

Module Leader:
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