Condensed Matter Physics

Lecturers:
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Aims and Outcomes:
The student will be expected to have knowledge of the following areas:

- Symmetry and periodicity in crystals
- Free Electron Gas. Fermi-Dirac statistics. Electronic contribution to thermal and electrical conductivity.
- Reciprocal lattice and the first Brillouin zone.
- The Schrödinger equation in a periodic potential. Bloch's theorem. Kronig-Penney model. Nearly free electron model. Tight-binding approximation.
- Semi-conductors. Silicon and Gallium-Arsenide bandstructure. Direct and indirect band-gaps. Optical properties of semiconductors.
- Motion of electrons in bands. Holes and their properties. Donor and acceptor states.
- Temperature dependence of semiconductor statistics. Fermi energy.
- Semiconductor matching rules. Work function. Semiconductor junctions. Metal-semiconductor contacts. Ohmic contacts.
- The ideal metal-oxide-semiconductor (MOS) diode. The SiO_2 MOS diode. The MOSFET.
- NMOS, PMOS and CMOS technologies. Devices. Limits to miniaturisation.
- Lattice dynamics. The monatomic linear chain (Brillouin Zone, dispersion relations, lattice modes, phonons). The diatomic chain (branches and energy bands). Bragg scattering, scattering from lattice modes, neutron diffraction.
- Lattice properties: Bose-Einstein statistics, specific heat, thermal conductivity.

Examination of the Course:
This course will be examined by two assignments (25%) and a 1 hr written examination (75%).. Students enrolled in the Advanced stream will receive two or three lectures which are distinct from the Normal stream and will attempt more challenging assignment questions. The examination will contain a question for the advanced stream only.

Text Book:
C. Kittel, *Introduction to Solid State Physics* (8^{th} Ed.)

Resources on the Web:
Lecture notes and other material for the component lectured by Dr Marks are available at `http://www.physics.usyd.edu.au/~nigel/phys3012`