

Tutorial Sheet – Lecture 8

Phonons

RA Hogg
r.hogg@shef.ac.uk

- 1) Draw the dispersion diagram for phonons and photons in a 1D diatomic system. Describe what is meant by;
Longitudinal phonons
Transverse phonons
Acoustic phonons
Optical phonons
- 2) The velocity of sound in silicon is $2.2 \times 10^5 \text{ cm.s}^{-1}$. Calculate the elastic constant of Si.
- 3) A laser of wavelength 514.5nm is scattered by phonons in a semiconductor. Two peaks are observed at 524.2nm and 525.4nm. Identify the phonons responsible and determine their energies.
- 4) Describe the difference between Fermions and Bosons. Provide examples of both.
- 5) Describe how at low temperatures the average number of phonons in a given mode may be approximated. Comment upon the validity of this approximation.
- 6) Draw the band-structure of a direct band-gap semiconductor and explain how hot carriers (created by the excitation of a laser with energy greater than the band-gap) relax and recombine. How is this different in an indirect band-gap semiconductor?