2. kolokvij iz Fizike trdne snovi

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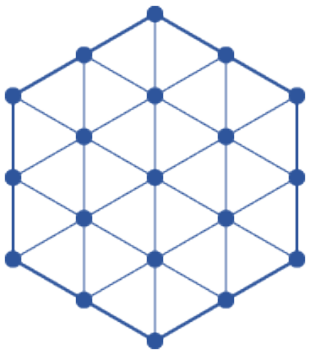
1. V germaniju z energijsko režo 0.67 eV sta efektivni masi elektronov in vrzeli 0.22 in 0.34 mase prostih elektronov. Germanij dopiramo z donorji – atomi arzena s koncentracijo 10^{20} m^{-3} in vezavno energijo 0.00127 eV. [In germanium the energy gap is 0.67 eV. The electron and hole effective masses are 0.22 and 0.34 free electron mass, respectively. We dope germanium with 10^{20} m^{-3} arsenic donors with the binding energy of 0.00127 eV.]

   (a) Oceni koncentracijo elektronov v prevodnem pasu pri temperaturi 1 K. [Estimate the electron density in the conduction band at 1 K.]

   (b) Oceni koncentracijo elektronov v prevodnem pasu pri temperaturi 300 K. [Estimate the electron density in the conduction band at 300 K.]

2. Obravnavaj mrežna nihanja trikotne ravninske mreže atomov z maso M, v kateri so najbližji sosedi povezani z vzmetmi s koeficientom raztezka K. Atomi se iz mirovnih leg lahko odmaknejo le v ravnini kristala. [In a triangular lattice of atoms with mass M the neighboring atoms are connected with springs with the spring constant K. The atoms can deviate from their equilibrium positions only in the plane of the crystal.]



   (a) Določi primitivno celico mreže, recipročno mrežo in prvo Brillouinovo cono. [Determine the primitive cell, the reciprocal lattice and the first Brillouin zone.]

   (b) Izračunaj in skiciraj disperzijo mrežnih nihanj z valovnim vektorjem v smeri zveznice sosednjih atomov. [Calculate and sketch the dispersion of lattice vibrations propagating in the directions of a line connecting two neighboring atoms.]

   (c) Izračunaj kotno odvisnost hitrosti zvoka. [Calculate the angular dependance of the speed of sound.]

   (d) Kolikšen je prispevek mrežnih nihanj k nizkotemperaturni specifični toploti kristala? [Calculate the contributions of lattice vibration to the low temperature specific heat.]