

**Week 3 Lecture 8 Quiz:  
Phonon Scattering: Part I**

**ECE 656: Electronic Conduction In Semiconductors**

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Purdue University, Fall 2013  
(Revised 9/13/13)

**Student's name:** \_\_\_\_\_

Answer the **multiple choice questions** below by choosing the **one, best answer**. Then ask **a question** about the lecture.

- 1) Compare the typical acoustic phonon (sound) velocity,  $v_s$ , to the average thermal velocity of electrons,  $v_{th}$ . Which of the following is true?
  - a)  $v_s \approx v_{th}$ .
  - b)  $v_s < v_{th}$ .
  - c)  $v_s \ll v_{th}$ .
  - d)  $v_s > v_{th}$ .
  - e)  $v_s \gg v_{th}$ .
  
- 2) Comparing optical and acoustic phonons near the center of the Brillouin zone, which of the following is true?
  - a) Optical phonon velocity **much less** than acoustic phonon velocity and optical phonon energy **much less** than acoustic phonon energy.
  - b) Optical phonon velocity **much less** than acoustic phonon velocity and optical phonon energy **much greater** than acoustic phonon energy.
  - c) Optical phonon velocity **much greater** than acoustic phonon velocity and optical phonon energy **much less** than acoustic phonon energy..
  - d) Optical phonon velocity **much greater** than acoustic phonon velocity and optical phonon energy **much greater** than acoustic phonon energy..
  - e) Optical phonon velocity **roughly equal** to acoustic phonon velocity and optical phonon energy **roughly equal** to acoustic phonon energy..
  
- 3) Which phonons are most responsible for **intravalley** scattering?
  - a) Longitudinal modes near the zone center.
  - b) Transverse modes near the zone center.
  - c) Longitudinal modes near the zone boundary.
  - d) Transverse modes near the zone boundary.
  - e) Both longitudinal and transverse modes near the zone center.

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- 4) What is “deformation potential” scattering?
- a) Scattering by acoustic phonons that is due to the change in bandgap (or band edge) due to a change in lattice spacing.
  - b) Scattering by optical phonons that is due to the change in bandgap (or band edge) due to a change in lattice spacing.
  - c) Scattering by either acoustic or optical phonons that is due to the change in bandgap (or band edge) due to a change in lattice spacing.
  - d) Scattering by defects in the crystal.
  - e) Scattering by an electrostatic dipole in the crystal.
- .
- 5) Which of the following scattering mechanisms occur in GaAs but not in Si?
- a) Acoustic deformation potential scattering.
  - b) Optical deformation potential scattering.
  - c) Ionized impurity scattering.
  - d) Polar optical phonon scattering.
  - e) None of the above.

**6) What question do you have about this lecture?**

**Turn in to Prof. Lundstrom in class on Friday.**