Week 8 Lecture 20 Quiz:
Coupled current equations and thermoelectric devices

ECE 656: Electronic Conduction In Semiconductors
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Purdue University, Fall 2013
(Revised 10/10/13)

Student’s name: ________________________________

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

1) What is the “power factor”
   a) $S\sigma$
   b) $S^2\sigma$
   c) $S^2\sigma T$
   d) $\kappa_L + \kappa_e$
   e) $\kappa_0/\kappa_L$

2) Where should the Fermi level be placed to maximize the power factor in an n-type semiconductor?
   a) Well below the conduction band edge, $E_C$
   b) Well below the conduction band edge, $E_C$
   c) Very close to the conduction band edge, $E_C$
   d) Very close to the valence band edge, $E_V$
   e) Well below the valence band edge, $E_V$

3) Which of the following is true about the location of the Fermi level to maximize the power factor in an n-type semiconductor?
   a) It is higher in 1D than in 2D and higher in 2D than in 3D.
   b) It is lower in 1D than in 2D and lower in 2D than in 3D.
   c) It is the same in 1D, 2D, and 3D.
   d) It is the same in 1D and 2D, but higher in 3D.
   e) It is the same in 2D and 3D, but lower in 1D.
4) The best thermoelectric materials all have one thing in common. What is it?
   a) A very high mobility.
   b) A very high conductivity.
   c) A very high Seebeck coefficient.
   d) A very low lattice thermal conductivity.
   e) A very low Peltier coefficient.

5) For a general (possibly anisotropic) material, we write:

   \[ \mathbf{E}_i = \rho_{ij} J_j + S_{ij} \partial_j T \]

Assume that \( J_x \) is non-zero and all other components are zero and that the temperature is uniform. What is \( \mathbf{E}_y ? \)

   a) \( \mathbf{E}_y = \rho_{yy} J_x \)
   b) \( \mathbf{E}_y = \rho_{xy} J_x \)
   c) \( \mathbf{E}_y = \rho_{yx} J_x \)
   d) \( \mathbf{E}_y = \rho_{y} J_y \)
   e) \( \mathbf{E}_y = \rho_{xy} J_y \)

6) What question do you have about this lecture?
Turn in to Prof. Lundstrom in class on Friday.