Week 12 Lecture 30 Quiz:
Near-equilibrium Measurements: II

ECE 656: Electronic Conduction In Semiconductors

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Student's name: _____

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

1) The measured mobility vs. temperature characteristic typically displays a maximum at a certain temperature. Which of the following statements is true at the maximum?
   a) The semiconductor becomes degenerate.
   b) The semiconductor becomes nondegenerate.
   c) The free carriers freeze out.
   d) Phonon scattering and ionized impurity scattering are equally important.
   e) Phonon scattering is much more important that ionized impurity scattering.

2) Assume that $\vec{B} = B_z \hat{z}$ what is J_y according to $J_i = \sigma_S \mathcal{E}_i - \sigma_S \mu_H \varepsilon_{ijk} \mathcal{E}_j B_k$?
   a) $J_y = \sigma_S \mathcal{E}_y$
   b) $J_y = -\sigma_S \mu_H \mathcal{E}_x B_z$
   c) $J_y = +\sigma_S \mu_H \mathcal{E}_x B_z$
   d) $J_y = \sigma_S \mathcal{E}_y - \sigma_S \mu_H \mathcal{E}_x B_z$
   e) $J_y = \sigma_S \mathcal{E}_y + \sigma_S \mu_H \mathcal{E}_x B_z$

3) We have seen that for parabolic bands in 2D with non-degenerate conditions, $\langle\langle \tau_m \rangle\rangle = \tau_0 \, \Gamma(s+2)/\Gamma(2)$. What is the Hall coefficient, $r_H \equiv \langle\langle \tau_m^2 \rangle\rangle / \langle\langle \tau_m \rangle\rangle^2$ is 2D?

   a) $r_H = \Gamma(2s+2)/[\Gamma(2)]$.
   b) $r_H = \Gamma(2s+2)\Gamma(2)/[\Gamma(s+2)]^2$
   c) $r_H = \Gamma(2s+2)\Gamma(s+2)/[\Gamma(2)]^2$
   d) $r_H = \Gamma(s+2)\Gamma(2)/[\Gamma(2s+2)]^2$
   e) $r_H = \Gamma(3s+2)\Gamma(2)/[\Gamma(2s+2)]^2$.

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4) Assume acoustic deformation potential (ADP) scattering (intravalley) dominates in a 2D semiconductor with parabolic energy bands. What is $\langle\langle \tau_m \rangle\rangle$?

a) $\langle\langle \tau_m \rangle\rangle = \tau_0$.

b) $\langle\langle \tau_m \rangle\rangle = \tau_0 \Gamma(1/2)/\Gamma(2)$.

c) $\langle\langle \tau_m \rangle\rangle = \tau_0 \Gamma(1)/\Gamma(2)$.

d) $\langle\langle \tau_m \rangle\rangle = \tau_0 \Gamma(3/2)/\Gamma(2)$.

e) $\langle\langle \tau_m \rangle\rangle = \tau_0 \Gamma(5/2)/\Gamma(2)$.

5) If the measured conductivity is independent of sheet carrier density in graphene, what is the dominant scattering mechanism likely to be?

a) Acoustic deformation potential scattering.
b) Optical deformation potential scattering.
c) Plasmon scattering.
d) Ionized impurity scattering.
e) Polar optical phonon scattering.

6) What question do you have about this lecture?

Turn in to Prof. Lundstrom in class on Friday, Nov. 8 .