Week 2 Lecture 5 Quiz:
Scattering and Fermi's Golden Rule

ECE 656: Electronic Conduction In Semiconductors
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Purdue University, Fall 2013
(revised 8/30/13)

Student's name: _____

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

1) Which of the following is generally true of the characteristic times? (Scattering time, τ, momentum relaxation time, τ_m, and energy relaxation time, τ_E.)
   a) $\tau > \tau_m > \tau_E$.
   b) $\tau > \tau_m < \tau_E$.
   c) $\tau < \tau_m > \tau_E$.
   d) $\tau < \tau_m < \tau_E$.
   e) $\tau \approx \tau_m \approx \tau_E$.

2) Which of the following assumptions does Fermi's Golden Rule make?
   a) Elastic scattering and infrequent scattering.
   b) Inelastic scattering and infrequent scattering.
   c) Weak scattering and infrequent scattering.
   d) Time independent scattering and weak scattering.
   e) Time dependent scattering and weak scattering.

3) When we write $\vec{p}' = \vec{p} + \hbar\vec{q}$, what are $\vec{p}'$ and $\vec{q}$?
   a) The quantity, $\vec{p}'$, is the final momentum of the electron and $\vec{q}$ is a Fourier component of the scattering potential.
   b) The quantity, $\vec{p}'$, is the final momentum of the electron and $\vec{q}$ is the momentum of the scattering potential.
   c) The quantity, $\vec{p}'$, is the final crystal momentum of the electron and $\vec{q}$ is a Fourier component of the scattering potential.
   d) The quantity, $\vec{p}'$, is the final energy of the electron and $\vec{q}$ is a Fourier component of the scattering potential.
   e) The quantity, $\vec{p}'$, is the final crystal momentum of the electron and $\vec{q}$ is the initial momentum.

4) For isotropic scattering, how is the scattering rate related to the density-of-states? (A subscript, "I" refers to the initial state and a subscript, "f" to the final state.)

a) $\tau(E_i) \propto D(E_i)$.

b) $\tau(E_i) \propto D(E_f)$.

c) $1/\tau(E_i) \propto D(E_i)$.

d) $1/\tau(E_i) \propto D(E_f)$.

e) $1/\tau(E_i) \propto D(E_i + E_f)$.

5) If the transition rate, $S(\vec{p}, \vec{p}')$, has a term, $\delta(E' - E \mp \hbar\omega)$, which of the following is true ($\hbar\omega > 0$)?

a) The scattering is isotropic and elastic.
b) The scattering is isotropic and inelastic.
c) The scattering is anisotropic and inelastic.
d) The scattering is inelastic.
e) The scattering is anisotropic.

6) What question do you have about this lecture?

Turn in to Prof. Lundstrom in class on Friday.