Week 10 Lecture 23 Quiz:
The Boltzmann Transport Equation

ECE 656: Electronic Conduction In Semiconductors

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Purdue University, Fall 2013

Student's name: _____

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

1) The equation of motion for an electron in k-space is $\frac{d\left(\hbar\vec{k}\right)}{dt} = \vec{F}_e$. What assumptions are necessary for this equation to be valid?

   a) Parabolic energy bands.
   b) Non-degenerate conditions.
   c) No quantum mechanical reflections.
   d) No B-field.
   e) No temperature gradients.

2) Under what conditions is this equation valid? $\frac{\partial f}{\partial t} + \vec{v} \bullet \nabla_r f + \vec{F}_e \bullet \nabla_p f = 0$

   a) No recombination-generation.
   b) Equilibrium.
   c) No scattering.
   d) Position independent effective mass.
   e) All of the above

3) What is the quantify, $\sum_{p'} S\left(\vec{p}' \rightarrow \vec{p}\right) f\left(\vec{p}'\right)\left[1 - f\left(\vec{p}\right)\right]$?

   a) The collision integral.
   b) The in-scattering rate.
   c) The out-scattering rate.
   d) The relaxation time approximation.
   e) The collision operator.

4) What is the quantity, $-\left(\frac{f(\vec{p})-f_0(\vec{p})}{\tau_m}\right)$?

a) The collision operator.
b) .The collision operator in the relaxation time approximation.
c) The solution to the steady-state Boltzmann equation.
d) The in-scattering term of the collision operator.
e) The out-scattering terms of the collision operator.

5) In the solution to the steady-state Boltzmann equation, $\delta f = \tau_m\left(-\frac{\partial f_0}{\partial E}\right)\vec{v}\bullet\vec{\mathcal{F}}$, what is the term $\vec{\mathcal{F}}$ called?

a) The electrochemical potential.
b) The chemical potential.
c) The statistical force.
d) The generalized force.
e) The electric field.

6) What question do you have about this lecture?

Turn in to Prof. Lundstrom in class on Wednesday, Oct. 30 .