Week 11 Lecture 27 Quiz:
Scattering: Relaxation Time Approximation

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) When we write the collision integral in the Relaxation Time Approximation,

$$\hat{C}f\left(\vec{r},\vec{p},t\right)=-\frac{\left(f-f_S\right)}{\tau_f\left(\vec{r},\vec{p}\right)},$$

what is the characteristic time, τ_f?

a) The scattering time.
b) The momentum relaxation time.
c) The energy relaxation time.
d) All of the above.
e) None of the above.

2) When we write the collision integral in the Relaxation Time Approximation,

$$\hat{C}f\left(\vec{r},\vec{p},t\right)=-\frac{\left(f-f_S\right)}{\tau_f\left(\vec{r},\vec{p}\right)},$$

why do we use f_S rather than the equilibrium, f_0?

a) Because we are not exactly at equilibrium.
b) To be sure that the number of carriers is conserved.
c) To the sure that the momentum of the carriers is conserved..
d) To the sure that the energy of the carriers is conserved..
e) To the sure that the heat of the carriers is conserved..

3) Under what conditions is the Relaxation Time Approximation,

$$\hat{C}f\left(\vec{r},\vec{p},t\right)=-\left(f-f_S\right)/\tau_f\left(\vec{r},\vec{p}\right)$$

valid?

a) Near equilibrium
b) Near equilibrium with Maxwell-Boltzmann statistics with elastic scattering.
c) Near equilibrium with Maxwell-Boltzmann statistics with isotropic scattering
d) Near equilibrium with elastic scattering or isotropic scattering with Maxwell Boltzmann statistics.
e) Near equilibrium with isotropic scattering or inelastic scattering with Maxwell Boltzmann statistics.

4) Which of the following statements is true under near equilibrium conditions?
   a) In general, the RTA accurately describes the in-scattering process.
   b) In general, the RTA accurately describes the out-scattering process.
   c) In general, the RTA accurately describes both the in- and out-scattering processes
   d) For specific conditions, the RTA accurately describes both in-scattering and out-scattering.
   e) None of the above.

5) Consider the following two equations;

$$\sum_{p'} S\left(\vec{p}', \vec{p}\right) f\left(\vec{p}'\right) - \sum_{p'} S\left(\vec{p}, \vec{p}'\right) f\left(\vec{p}\right) = 0 \qquad \text{(i)}$$

$$S\left(\vec{p}', \vec{p}\right) f\left(\vec{p}'\right) - S\left(\vec{p}, \vec{p}'\right) f\left(\vec{p}\right) = 0 \qquad \text{(ii)}$$

What are these equations statement of ?

   a) detailed balance
   b) steady-state conditions.
   c) (i) detailed balance and (ii) steady-state conditions.
   d) (i) steady-state conditions and (ii) detailed balance.
   e) none of the above

6) What question do you have about this lecture?

Turn in to Prof. Lundstrom in class on Friday, Nov. 1 .