Week 13 Lecture 31 Quiz:
Balance Equations: I

ECE 656: Electronic Conduction In Semiconductors

Mark Lundstrom
Purdue University, Fall 2013
(Revised 11/15/13)

Student's name: _____

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

1) In this lecture, we wrote the general balance equation for a quantity, n_ϕ, as $\frac{\partial n_\phi}{\partial t} = -\nabla \bullet \vec{F}_\phi + G_\phi - R_\phi$. What assumption is this equation based upon?

a) That the semiconductor is non-degenerate.
b) That the bandstructure is parabolic.
c) That the temperature is uniform.
d) That the electron temperature is equal to the phonon temperature.
e) Only that the BTE is valid.

2) If $\phi(\vec{p}) = (E - F_n)\vec{\upsilon}$, where E is the total energy, then what is the associated flux in the balance equation?

a) The kinetic energy flux.
b) The total energy flux.
c) The heat flux.
d) The internal energy flux.
e) The particle flux.

3) What is the quantity, $-q\mathcal{E}_i \left\{ \frac{1}{L} \sum_{\vec{p}} \frac{\partial \phi}{\partial p_i} f \right\}$?

a) The physical quantity term in the balance equation.
b) The associated flux in the balance equation.
c) The generation term in the balance equation.
d) The recombination term in the balance equation.
e) The drift term in the associated flux.

(continued on next page)

4) When we write the recombination term as $R_\phi = \dfrac{n_\phi - n_\phi^0}{\langle \tau_\phi \rangle}$, what assumption are we making?

a) Near equilibrium.
b) The Relaxation Time Approximation.
c) Non-degenerate carrier statistics.
d) Steady-state conditions.
e) Only that the BTE is valid.

5) When we write the 1D current equation as $I_x = n_L q \mu_n \mathcal{E}_x + q D_n \, dn_L / dx$, what assumptions are we making?

a) Near-equilibrium conditions.
b) Time variations slow in comparison to the momentum relaxation time.
c) Uniform temperature.
d) All of the above.
e) b) and c) above.

6) What question do you have about this lecture?

Turn in to Prof. Lundstrom in class on Friday, Nov. 15 .