Quiz Answers: Week 14
ECE 656: Electronic Conduction In Semiconductors
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Lecture 34-35 Quiz:

1) When simulating trajectories, \((\vec{r}(t),\vec{p}(t))\), in phase space, which of the following is true?
   a) \(\vec{r}(t)\) is continuous and \(\vec{p}(t)\) is continuous.
   b) \(\vec{r}(t)\) is discontinuous and \(\vec{p}(t)\) is continuous.
   c) \(\vec{r}(t)\) is continuous and \(\vec{p}(t)\) is discontinuous.
   d) \(\vec{r}(t)\) is discontinuous and \(\vec{p}(t)\) is discontinuous.
   e) None of the above

2) What is “self scattering”?
   a) A many body effect in which an electron interacts with itself.
   b) An electron-electron scattering event in which an electron scatters from another electron.
   c) An electron-electron scattering event in which an electron scatters from the entire plasma of all the electrons.
   d) A mathematical technique that simplifies the computation of free-flight times.
   e) A mathematical technique that simplifies the computation of the final scattering state.

3) How does the self-scattering rate vary with energy?
   a) It is independent of energy.
   b) It increases monotonically with energy.
   c) It increases monotonically with energy.
   d) It depends on the energy dependence of all the other scattering processes.
   e) As energy to the power of a characteristic exponent, \(s\).

4) To simulate a carrier trajectory by Monte Carlo simulation, we choose four random numbers. What do these four random numbers determine?
   a) The position, momentum, energy, and velocity just before a collision.
   b) The position, momentum, energy, and velocity just after a collision.
   c) The duration of the free flight, the scattering event that terminated the free flight, and the two angles that describe the direction just after scattering.
   d) The duration of the free flight, the scattering event that terminated the free flight, the energy just after scattering, and the direction just after scattering.
   e) The duration of the free flight, the scattering event that terminated the free flight, the energy just after scattering, and the position just after scattering.

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5) Which of the following is true?

a) Monte Carlo simulation is a numerical technique to solve the BTE.
b) Monte Carlo simulation is a numerical technique to solve the near-equilibrium BTE.
c) Monte Carlo simulation is a numerical technique to solve the balance equations.
d) **Monte Carlo simulation is a numerical technique that can go beyond the BTE by including e-e correlations.**
e) Monte Carlo simulation is a numerical technique that can go beyond the BTE by including quantum transport effects.

**Lecture 36 Quiz:**

1) What is meant by an “open quantum system” is a device context?
   a) One that can interact with the external environment.
   b) One that can exchange particles with the outside world.
   c) One in which the quantum states have a finite lifetime.
   d) **All of the above.**
   e) None of the above.

2) When treating a quantum device with “Landauer” contacts which of the following statements is true?
   a) There is a well-defined $E(\k)$ everywhere.
   b) There is a well-defined $E(\k)$ in the device, but not in the contacts.
   c) There is a well-defined $E(\k)$ in the injecting contact, but not in the device or collecting contact.
   d) There is a well-defined $E(\k)$ in the collecting contact, but not in the device or in the injecting contact.
   e) **There is a well-defined $E(\k)$ in both contacts, but not in the device.**

3) What is the quantity: $[G(E)] = (E[I] - [H] - [\Sigma_1] - [\Sigma_2])^{-1}$?
   a) The Hamiltonian.
   b) The contact self energy.
   c) The scattering self energy.
   d) **The retarded Green’s function.**
   e) The source injection matrix.

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4) Which of the following statements is true about the local density of states in a device?

a) It divides into parts, that can be filled by contact 1, by contact 2, or by scattering.
b) It can be computed either quantum mechanically or semi-classically.
c) It can change with bias.
d) It can change in the presence of scattering.

**e) All of the above.**

5) Which of the following is true about the NEGF approach to quantum transport?

**a) For ballistic transport, it is equivalent to solving the Schroedinger equation.**

b) In principle, it provides a complete and rigorous description of a device.
c) In practice, it is easier to solve than the BTE.
d) It cannot, in principle, include inelastic scattering.
e) It cannot, in principle, include inelastic and isotropic scattering.