

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 $E(\vec{k})$ everywhere.
- b) There is a well-defined $E(\vec{k})$ in the device, but not in the contacts.
- c) There is a well-defined $E(\vec{k})$ in the injecting contact, but not in the device or collecting contact.
- d) There is a well-defined $E(\vec{k})$ in the collecting contact, but not in the device or in the injecting contact.
- e) **There is a well-defined $E(\vec{k})$ 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.