Quiz Answers: Week 6
ECE 656: Electronic Conduction In Semiconductors
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Lecture 13 Quiz :

1) What are the special properties of a contact in the Landauer model?
   a) Strong inelastic scattering keeps them near equilibrium.
   b) Any electron incident upon the contact is completely absorbed (no reflections).
   c) Each contact is described by its own Fermi level.
   d) Contacts have a very large number of channels (modes) compared to the device.
   e) All of the above.

2) Which of the follow is true about the Landauer expression for current:
   $I = (2q/h)\int \{\gamma \pi D(E)/2\}(f_1 - f_2)dE$
   a) It applies to electrons in the conduction band.
   b) It applies to electrons in the valence band.
   c) It applies to holes in the valence band.
   d) It applies to **both** electrons in the conduction band and holes in the valence band.
   e) It applies to both electrons in the conduction band and electrons in the valence band.

3) What are the units of the quantity, $\gamma \pi D(E)/2$?

   a) Energy
   b) One over energy
   c) Ohms
   d) One over Ohms or Siemens.
   e) The quantity is unitless.

4) What is meant by the term "near-equilibrium" transport?

   a) The contacts stay very close to equilibrium.
   b) The Fermi level in the contact is close to its equilibrium value.
   c) The Fermi levels of the two contacts, f_1 and f_2, can be replaced by the equilibrium Fermi level.
   d) The difference in Fermi levels between the two contacts can be replaced by a first order Taylor series expansion of $f_1 - f_2$.
   e) The temperature of the two contacts is the same.

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5) Consider a small nano-device under bias with a steady-state current flowing. Which of the following is true?

a) One contact tries to fill states in the device and the other one tries to empty them.
b) Both contacts try to fill states in the device.
c) Both contacts try to empty states in the device.
d) All of the above.
e) None of the above.

Lecture 14 Quiz:

1) Mathematically, the number of modes (channels) at energy, *E*, is proportional to what?

a) The density of states.
b) The velocity.
c) The density of states times velocity.
d) The density of states divided by velocity.
e) The deBroglie wavelength.

2) How is the transmission, *T,* related to the mean-free-path for backscattering, λ, and the length of the resistor, L?
a) $T = e^{-L/\lambda}$.
b) $T = e^{+L/\lambda}$.
c) $T = \lambda / L$.
d) $T = L/\lambda$.
e) $T = \lambda/(\lambda + L)$**.**

3) For parabolic band semiconductors, $M(E)$ is independent of energy (above the bottom of the conduction band) for which of the following cases?

a) 1D
b) 2D
c) 3D
d) 1D and 2D
e) 2D and 3D

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4) Under what conditions does the Landauer expression for current, $I = \frac{2q}{h}\int T(E)M(E)(f_1 - f_2)dE$, apply?

a) Near-equilibrium.
b) For near-ballistic transport conditions, $L << \lambda$.
c) For diffusive transport conditions, $L >> \lambda$
d) Far from equilibrium.
e) All of the above.

5) When should we NOT use the Landauer expression, $I = \frac{2q}{h}\int T(E)M(E)(f_1 - f_2)dE$?

a) When quantum transport is important.
b) When semi-classical transport dominates.
c) When the temperatures of the two contacts are different.
d) When hole conduction dominates.
e) When it is necessary to spatially resolve quantities inside the device.