ECE 656 Homework (Week 11)

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1) Consider a semiconductor with a slowly varying effective mass, $m^*(x)$. Derive the equation of motion for an electron in *k*-space analogous to the result for a constant effective mass:

$$\frac{d(\hbar k_x)}{dt} = F_e = -\frac{dE_C(x)}{dx}.$$

2) Consider a semiconductor with a position dependent effective mass and electron affinity, $\chi(x)$, so that

$$E_C(x) = E_{vac} - \chi(x) - qV(x),$$

where E_{vac} is a constant, reference energy (the vacuum level) and $V(x)$ is the electrostatic potential.

Solve the steady-state BTE in the relaxation time approximation and compare your result to the results for a constant effective mass and electron affinity:

$$J_{nx} = \sigma\frac{d(F_n/q)}{dx} - \sigma S\frac{dT}{dx}$$

3) Solve the steady-state BTE in the Relaxation Time Approximation and derive an expression for the transport tensor, $[\kappa_0]_{ij}$ in the absence of a B-field.