

ECE 656: Fall 2009
Lecture 1 Homework

- 1) Assume a nonparabolic energy band structure described by

$$E(k)[1 + \alpha E(k)] = \frac{\hbar^2 k^2}{2m^*(0)}.$$

where

$$\frac{1}{m^*(0)} = \frac{1}{\hbar^2} \left. \frac{d^2 E(k)}{dk^2} \right|_{k=0}.$$

For this bandstructure, deduce the velocity, $v(k)$ as a function of k .

HW1 solution:

$$E(k)(1 + \alpha E(k)) = \hbar^2 k^2 / (2m^*(0))$$

$$E(k) + \alpha E^2(k) =$$

$$\frac{dE}{dk} + 2\alpha E \frac{dE}{dk} = \hbar^2 k / (m^*(0))$$

$$\frac{1}{\hbar} \frac{dE}{dk} (1 + 2\alpha E(k)) = \frac{k}{m^*(0)}$$

$$v(k) = \frac{\hbar k}{m^*(0)(1 + 2\alpha E)} = \frac{\hbar k}{m^*(E)}$$

$$m^*(E) = m^*(0) [1 + 2\alpha E(k)]$$

$$v(k) = \frac{\hbar k}{m^*(E)}$$