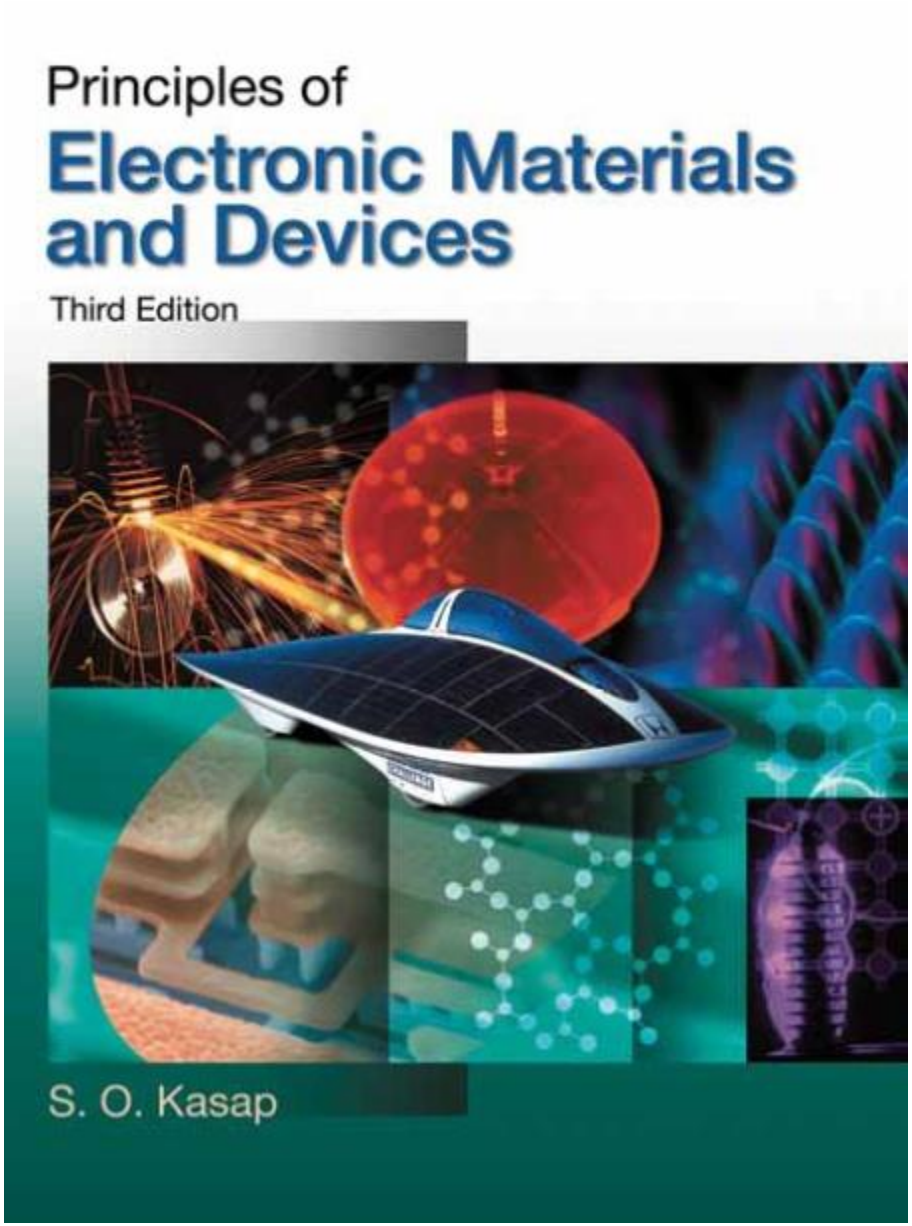
AAST-Cairo

EC210
Solid State Electronics
Spring 2014

Solution of Schrodinger Eq.
Heisenberg Uncertainty Principle



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Kasap:

- Page 211 Example 3.5
- Page 212-220

Applications of Schrödinger equation
Free Particle

A free particle whose mass is m and energy is E

Let V(x)=0 in Schrodinger equation

$$-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2}+\boldsymbol{V}(x)\psi(x)=E\psi(x)$$

$$\frac{d^2\psi(x)}{dx^2}=-\frac{2mE}{\hbar^2}\psi(x) \qquad k^2=\frac{2mE}{\hbar^2}$$

$$\frac{d^2\psi(x)}{dx^2}=-k^2\psi(x)$$

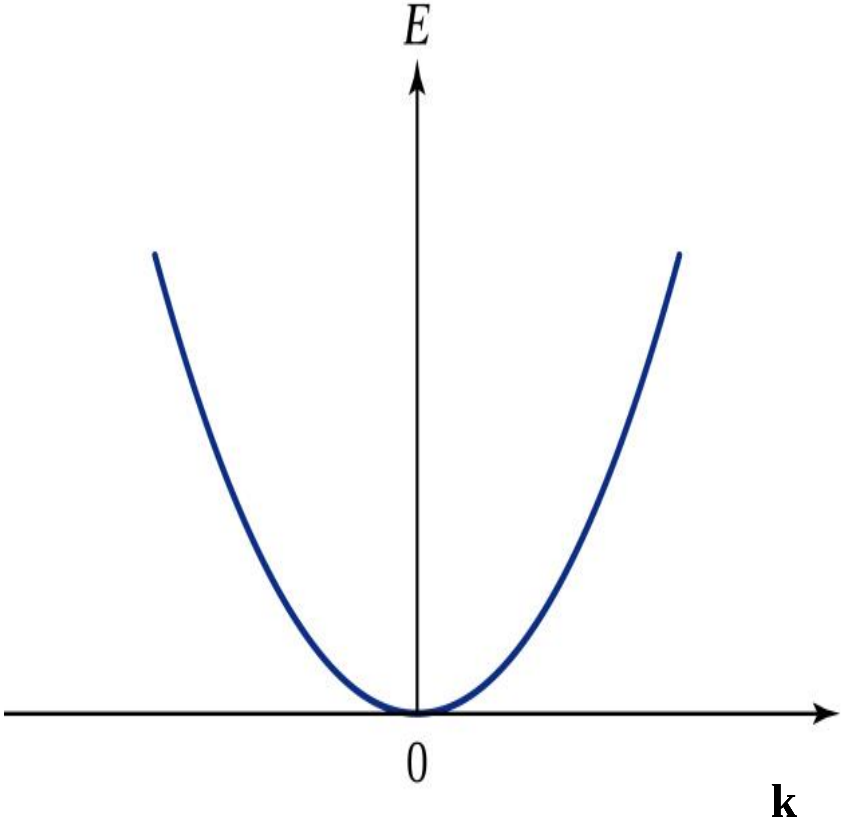
The solution of this differential equation is in the form:

$$\Psi(x) = A\, e^{jkx} \quad \text{or} \quad B\, e^{-jkx}$$

$$\Psi(x,t) = \Psi(x)\, e^{-j\omega t}$$

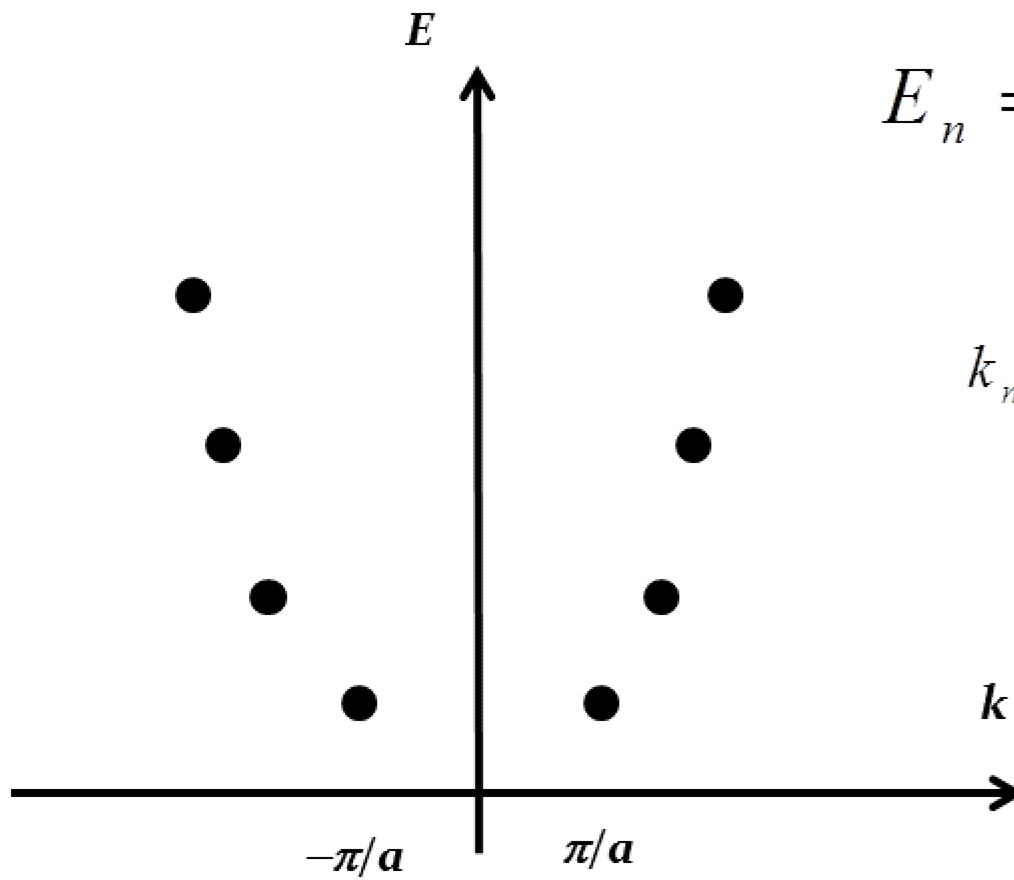
$$\Psi(x,t) = A\, e^{j(kx-\omega t)} \quad \textit{or} \quad B\, e^{-j(kx+\omega t)}$$

$$E = \frac{\hbar^2 k^2}{2m}$$



Free Particle

Particle in a potential well



$$E_n = \frac{\hbar^2 k_n^{\ 2}}{2m}$$

$$k_n = \frac{n\pi}{a}$$

3.4 Heisenberg's Uncertainty Principle

$$\Delta x \cdot \Delta p_x \geq \hbar$$

We can not exactly and simultaneously know both the position and momentum of particle along a given coordinate

$$\Delta t \cdot \Delta E \geq \hbar$$