Physics 475, Spring 2010
Problem Set 7
Due Tuesday, March 30.

Problems from Boas:

Chapter 6:
7.19, 10.11, 10.16

Chapter 7:
5.2

Additional Problem

Consider the time-independent Schrödinger equation in one dimension,

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

where $\hbar$, m and E are constants, and $V(x)$ is a fixed function of x.

Consider solutions $\psi_1(x)$ with $E = E_1$, and $\psi_2(x)$ with $E = E_2$, where $\hbar$, m and $V(x)$ are the same in both cases but $E_1 \neq E_2$.

Show that ψ_1 and ψ_2 are orthogonal in the sense that

$$\int_{-\infty}^{\infty} dx\,\psi_1(x)\psi_2(x) = 0$$

if $\psi_1(\pm\infty) = \psi_2(\pm\infty) = 0$ and $\int_{-\infty}^{\infty} dx\,\psi_1(x)\psi_2(x)$ is finite.

Hint: Multiply the equation for ψ_1 by ψ_2 and vice versa. Then take the difference of the two resulting equations and integrate over x. (Recall our discussion of orthogonality and Fourier series.)