UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Department of Physics

Physics 100A — Summer 2004

Prof. Jean Carlson

ASSIGNMENT 5

Part A due Wednesday, July 21. Part B due Monday, July 26.

Read Chapter 12 of Boas, and the sections on generalizations to function spaces which are in the book chapters on the Physics 100A course web site (http://www.eres.library.edu under Physics 100A). At this point, Boas will become increasingly useful for the course materials.

DUE WEDNESDAY, JULY 21:

Do the following problems in Boas:

Chapter 12, Section 1 (page 485): 6

Chapter 12, Section 2 (page 488): 2

In addition, do the following problems:

(1). For the ordinary differential equation:

$$(1-x^2)y''(x) - xy'(x) + n^2y(x) = 0$$

(for the Chebyshev polynomials) determine the inner product (specifically the weight function $w(x)$) which make the differential operator Hermitian in the vector space of functions on the interval $-1 \le x \le 1$ with Dirichlet boundary conditions $y(\pm 1) = 0$.

(2). A set of functions $\{u_n(x)\}$ satisfy the Sturm-Liouville equation

$$\frac{d}{dx}\left[p(x)\frac{d}{dx}u_n(x)\right] + \lambda_n w(x)u_n(x) = 0.$$

The functions $u_n(x)$ and $u_m(x)$ satisfy the boundary conditions that lead to orthogonality. The corresponding eigenvalues are distinct. Prove that for appropriate boundary conditions $u'_n(x)$ and $u'_m(x)$ are orthogonal with $p(x)$ as the weight function.

PART B DUE MONDAY, JULY 26:

Chapter 12, Section 4 (page 290): 2, 4

Chapter 12, Section 5 (page 495): 2, 13

Chapter 12, Section 6 (page 498): 4, 6