Intro to Quantum Computing EECE 622: Homework 4 - Due Friday 3, 2012
Team Members:

(I) Prove that

$$\sigma_x \sigma_y \sigma_z = iI, \tag{1}$$

where σ_x, σ_y, and σ_z are the three Pauli matrices and I is the identity matrix.

(II) If a spin is in the qubit state (which is properly normalized)

$$|\psi>=\frac{1}{\sqrt{10}}(3|0>-|1>), \tag{2}$$

what is the probability to find a value of $\frac{\hbar}{2}$ if you measure the y-component of the spin.

(III) Show that the matrix $\sqrt{NOT}$ given by

$$\begin{pmatrix} \frac{1+i}{2} & \frac{1-i}{2} \\ \frac{1-i}{2} & \frac{1+i}{2} \end{pmatrix}. \tag{3}$$

is unitary.

(IV) What is the 4X1 column vector resulting from the following tensor product

$$(H \otimes \sigma_x)(|0> \otimes |1>) \tag{4}$$

where H is the Hadamard matrix

$$H = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}? \tag{5}$$

(V) Compute the following Kronecker product $H \otimes H \otimes H$ where H is the Hadamard Matrix.

(VI) What is the average value of the tensor product

$$H \otimes \sigma_z \tag{6}$$

(where H is the Hadamard matrix and σ_z is the Pauli matrix) in the 2-qubit state given by

$$[\frac{1}{\sqrt{2}}(|0> - |1>)] \otimes [\frac{1}{\sqrt{2}}(|0> + |1>)]? \tag{7}$$