HW #6
Intermediate Quantum 491

Townsend problems from Chapter 3: 3.2, 3.3, 3.4, 3.5, 3.9, 3.14, 3.15, 3.17, 3.19, 3.20

#11 Start with the 3x3 Euclidean rotation matrices (as say given in your mechanics textbook). Calculate the corresponding generators $\hat{J}_x/\hbar, \hat{J}_y/\hbar, \hat{J}_z/\hbar$. Diagonalize $\hat{J}_z/\hbar$ and obtain the similarity transformation $\hat{S}$. Show that in this new basis (called the spherical basis) $\hat{J}_z/\hbar$ is diagonal with values $\hbar, 0, -\hbar$ on the diagonal (this is typically written as $[\hat{J}_z] = diag[\hbar, 0, -\hbar]$). Use the similarity transformation to calculate the matrices $\hat{J}_x/\hbar$ and $\hat{J}_y/\hbar$. Check that you get the same as given in the textbook. Finally, show that $\hat{S}^\dagger R^E(\theta\hat{y})\hat{S} = R(\theta\hat{y})$ as in problem 3.19.