J08Q.2 - Spin in a Magnetic Field

Problem

An electron is subject to a uniform magnetic field $\vec{B}_0 = B_0\hat{z}$ and occupies the spin eigenstate $|\uparrow\rangle$. At time $t = 0$, an additional time-dependent magnetic field $B_1(t) = B_1(\hat{x}\cos\omega t + \hat{y}\sin\omega t)$ is turned on. Calculate the probability of finding the electron with its spin along the negative z-axis at time $t > 0$. Ignore spatial degrees of freedom.