This thesis investigates the magnetization dynamics of cylindrical NiFe magnetic nanoparticles (MNPs), fabricated by template-assisted pulsed electrodeposition and differential chemical etching technique. The application of different magnetic field configurations to control the MNPs can manipulate the pathways leading to cell death, playing a pivotal role in cancer treatment. In an alternating magnetic field, magnetic hysteresis of the MNPs results in heat dissipation that causes necrosis of cancer cells. For uniform magnetic fields, the biaxial field configuration has been shown to be the most efficient magneto-actuated cell apoptosis method, which maximized the induced magnetic torque. For non-uniform magnetic fields, MNPs in a strong vertical magnetic field gradient were able to apply sufficient force on the cell to trigger the intracellular pathway for cell apoptosis, thus significantly reducing cell viability. In contrast, MNPs in an alternating magnetic field gradient can effectively rupture the cell membrane leading to higher lactate dehydrogenase leakage and lower cell viability, proving to be an effective induction of cell death via necrosis. The capability of the MNPs as both magnetic hyperthermia and magneto-actuation cell destruction agents is demonstrated by inducing different cell death signaling pathways, exemplifying the intricate interplay between apoptosis and necrosis.