The coexistence of antiferromagnetism with superconductivity is theoretically studied within the $t$-$J$ model with the Zeeman term included. The strong electron correlations are accounted for by means of the extended Gutzwiller projection method [1] within a statistically-consistent approach proposed recently [2]. The phase diagram on the band filling - magnetic field plane is obtained, and subsequently the system properties (magnetization curves, superconducting gaps, free-energy profiles) are analyzed for the band filling $n = 0.97$. In this regime the results resemble those observed recently in the heavy fermion systems $\text{CeCo(In}_1-x\text{Cd}_x)_5$ and $\text{CeRhSi}_3$. Namely, (a) with the increasing magnetic field the system evolves from AF+SC coexisting phase, through antiferromagnetic phase, towards normal state with nonzero spin polarization (ferromagnetic state); (b) the onset of superconducting order circumscribes antiferromagnetic magnetization. The superconducting gap has both singlet and staggered-triplet components, a consequence of its coexistence with antiferromagnetism. The work was supported by Ministry of Higher Education and Science, Grants Nos. N N202 173735 and N N202 128736.