In 1937, Majorana gave a “symmetric theory of electrons and positrons,” in which there might be no distinction between spin-1/2 particles and antiparticles.

E. Majorana,
Majorana noted that this theory doesn’t apply to charged particles like electrons and positrons, but might apply to neutrinos.

However, in a gauge theory, interacting fermions and antifermions have different quantum numbers, and cannot form Majorana states.

Interacting neutrinos carry nonzero weak isospin and weak hypercharge in the Glashow-Weinberg-Salam model, and antineutrinos carry the opposite “charges”.

Hence, these neutrinos cannot form Majorana states (unless one only considers electric-charge conjugation as defining particles and antiparticles).
The literature appears to consider two different possible forms for the hypothetical Majorana neutrino states (in terms of 4-spinors),

$$\psi_L = \frac{\nu_L + \bar{\nu}_R}{\sqrt{2}} \quad \text{and} \quad \psi_L = \frac{\nu_L + \bar{\nu}_L}{\sqrt{2}}$$

The first form would imply, for example, that the decays $\pi^+ \rightarrow \mu_R^+ \nu_L$, $\pi^+ \rightarrow \mu_R^+ \bar{\nu}_R$, could occur with roughly equal rates, and hence conventional neutrino beams would be 50:50 neutrino and antineutrino, contrary to experiment.

The second form would imply that the electroweak coupling constant $g$ would have to be $\frac{4}{\sqrt{2}}$ larger to keep the observed rates of single-neutrino interactions with an internal $W$ the same. But the, to keep the Weinberg angle the same, the coupling constant $g'$ would also have to be multiplied by $\frac{4}{\sqrt{2}}$, in disagreement with the observed width of the $Z^0$ by 200 $\sigma$.

Conventional wisdom is that the only experiment which could determine whether of not neutrinos are Majorana states is neutrinoless double-beta decay. However, this view was developed before the $W$ and $Z$ gauge bosons were discovered, and it has been overlooked that experiments on the decay of the $W$ and $Z$ strongly exclude that the known light neutrinos are Majorana states (while permitting Majorana mass terms, neutrinoless double beta decay, and the see-saw mechanism).
Thank you.