Bounded and stable solutions for nonlinear second order neutral difference equation

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Abstract: Using the techniques connected with the measure of noncompactness we investigate the neutral difference equation of the following form

\[ \Delta \left( r_n \left( \Delta \left( x_n + p_n x_{n-k} \right) \right)^\gamma \right) + q_n x_n^\alpha + a_n f(x_{n+1}) = 0, \]

where \( x : \mathbb{N}_k \to \mathbb{R}, a,p,q : \mathbb{N}_0 \to \mathbb{R}, r : \mathbb{N}_0 \to \mathbb{R} \setminus \{0\}, f : \mathbb{R} \to \mathbb{R} \) is continuous and \( k \) is a given positive integer, \( \alpha \geq 1 \) is a ratio of positive integers with odd denominator, and \( \gamma \leq 1 \) is ratio of odd positive integers; \( \mathbb{N}_k := \{k, k+1, \ldots\} \). Sufficient conditions for the existence of a bounded or stable of a special type solution are presented.