Spectra of Graphs and Closed Distance Magic Labelings

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Let $G = (V, E)$ be a graph of order n. A closed distance magic labeling of G is a bijection $\ell\colon V(G) \to \{1, \ldots, n\}$ for which there exists a positive integer k such that $\sum_{x \in N[v]} \ell(x) = k$ for all $v \in V$, where $N[v]$ is the closed neighborhood of v. We consider the closed distance magic graphs in the algebraic context. In particular we analyze the relations between the closed distance magic labelings and the spectra of graphs. These results are then applied to the strong product of graphs with complete graph or cycle and to the circulant graphs. We end with a number theoretic problem whose solution results in another family of closed distance magic graphs somewhat related to the strong product.