Cospectral Mates of Starlike Trees

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A tree which has exactly one vertex of degree greater than two is called starlike. A graph is said to be determined by the spectrum (DS for short) if there is no other nonisomorphic graph with the same spectrum. It seems to be a hard problem to determine DS starlike trees. Therefore we consider the converse of this problem and, namely try to find graphs cospectral to starlike trees. To do this, we introduce a generalized notion of characteristic polynomials. Let $G$ be a graph with the vertex set $V(G) = \{1, \ldots, n\}$ and $P = \{P_1, \ldots, P_m\}$ be a partition of vertices. The generalized characteristic polynomial of $G$ with respect to $P$ is defined to be

$$\chi_P(G) = \det(\text{diag}(x_1, x_2, \ldots, x_n) - A),$$

where $A$ is the adjacency matrix of $G$ and $x_1, x_2, \ldots, x_n$ are indeterminants such that $x_i = x_j$ if $i, j \in P_k$ for some $1 \leq k \leq m$. The notion of cospectrality with respect to these polynomials is presented. Finally, we show how this notion can be used in determining the cospectral mates of starlike trees.