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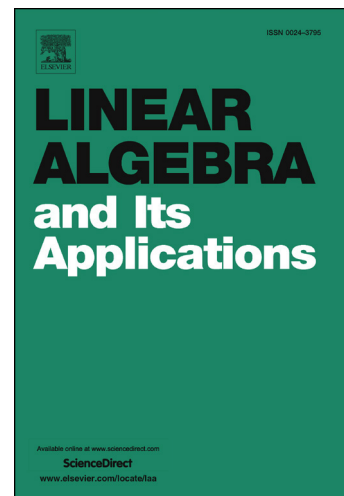
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# The characteristic polynomial of lexicographic product of graphs

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## Abstract

Let  $G$  and  $H$  be two simple graphs. In this paper, the characteristic polynomial of  $G[H]$ , the lexicographic product of  $G$  and  $H$ , is determined. As an application, the characteristic polynomial and the spectrum of  $G[H]$  are obtained explicitly when  $H$  has exactly one or two main eigenvalues.

*Keywords:* Lexicographic product, Main eigenvalue, Characteristic polynomial, Spectrum

*2000 MSC:* 05C50

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## 1. Introduction

The characteristic polynomial of a graph is defined as the characteristic polynomial of its adjacency matrix. The spectrum, eigenvalues, eigenvectors and eigenspaces of a graph are defined similarly. Let  $G$  be a graph with  $\{1, 2, \dots, m\}$  as its vertex set, let  $H_1, H_2, \dots, H_m$  be  $m$  disjoint graphs. The generalized lexicographic product, denoted by  $G[H_1, H_2, \dots, H_m]$ , is formed by taking  $H_1, H_2, \dots, H_m$ , and then joining every vertex of  $H_i$  to every vertex of  $H_j$  whenever  $i$  is adjacent to  $j$  in  $G$ . When  $H_1 = H_2 = \dots = H_m = H$ , the generalized lexicographic product  $G[H_1, H_2, \dots, H_m]$  is reduced to the lexicographic product  $G[H]$ . The lexicographic product of graphs is a binary operation which can generate new graphs from old ones. Different from other binary operations such as Cartesian product and strong product of graphs [6], lexicographic product of graphs does not satisfy commutative law and its characteristic polynomial can not be determined by that of the two constituent graphs in general.

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