

## OPERATIONS ON SPECTRAL FUZZY GRAPHS

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**Abstract:** The operations in spectral fuzzy graphs such as Cartesian product, strong product, bipartite double, Kronecker product and Lexicographic product (composition) are analysed to elucidate the impact of eigenvalue spectra. Also, the properties are derived which delves the effect on spectral fuzzy graphs.

**Keywords and Phrases:** Fuzzy graphs, Spectral analysis, Graph operations, Cartesian product, Strong product, Bipartite double, Kronecker product, Fuzzy eigenvalues.

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### 1. Introduction

Spectral graph theory investigates the spectral properties of graphs, focusing on their structural and spectral attributes [9]. This field emerged from the application of algebraic techniques to graph theory [5], particularly examining the eigenvalues and eigenvectors of matrices associated with a graph, such as the adjacency matrix ( $\lambda$ ), and the Laplacian matrix ( $\vartheta$ ). Essam El Seidy computed the spectra of fundamental graphs resulting from various graph operations [8]. Comprehending the impact of these operations on the spectral properties of graphs is fundamental in domains of network analysis.

The concept of fuzzy graphs [17], introduced by L.A. Zadeh in 1965, addresses uncertainty in graph theory [10]. Kauffmann initially introduced fuzzy graphs [4], and Rosenfeld [14] subsequently incorporated fuzzy relations into their framework.