

**ON THE SPECTRUM OF SECOND ORDER $(\tilde{p}, \tilde{q})$ -DIFFERENCE
OPERATOR OVER THE SEQUENCE SPACE ℓ_p ($1 < p < \infty$)**

N. Kalita and A. J. Dutta*

Department of Mathematics,
Gauhati University,
Guwahati - 781014, Assam, INDIA

E-mail : nkalita@gauhati.ac.in

*Department of Mathematics,
Pragjyotish College,
Guwahati - 781009, Assam, INDIA

E-mail : amar_iasst@yahoo.co.in

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Abstract: This article presents a detailed analysis of the spectral and fine spectral properties of the second-order $(\tilde{p}, \tilde{q})$ -difference operator $\Delta_{\tilde{p}, \tilde{q}}^2$, where $(0 < \tilde{q} < \tilde{p} \leq 1)$. The operator extends the classical $\tilde{q}$ -difference operator and is examined within the Banach space ℓ_p ($1 < p < \infty$). In this setting, $\Delta_{\tilde{p}, \tilde{q}}^2$ admits a matrix representation characterized by a lower triangular structure with three nonzero diagonals.

Keywords and Phrases: Spectrum, infinite matrices, sequence space, $(\tilde{p}, \tilde{q})$ -analog.

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1. Introduction

Spectral theory is a fundamental area of modern functional analysis with numerous applications. Mainly, it focuses on certain inverse operators, their essential characteristics, and how they relate to the original operators. These inverse operators often appear naturally when solving various types of equations, such as systems