

Importance of Eigenvalues in Computational and Applied Sciences

Dr. Milind Madhukar Sakalkale

Department of Mathematics

Sahyadri Bahujan Vidya Prasarak Samajs Sahakar Maharshi

Bhausahab Santuji Thorat College of Arts, Science & Commerce, Sangamner, Ahmednagar

Abstract: *Eigenvalues are fundamental mathematical concepts widely used in computational and applied sciences to analyze and solve complex real-world problems. They are derived from square matrices and provide critical information about system behavior, stability, and transformation properties. In engineering, eigenvalues are used in structural analysis, vibration studies, and control systems to determine stability and resonance conditions. In data science and machine learning, they play a key role in dimensionality reduction techniques such as Principal Component Analysis (PCA). Additionally, eigenvalues are essential in solving differential equations, studying quantum mechanical systems, image processing, and network analysis. The ability of eigenvalues to simplify complex matrix problems into meaningful interpretations makes them a powerful tool in modern scientific research and technological applications. This paper highlights the theoretical significance and practical applications of eigenvalues across various disciplines.*

Keywords: Eigenvalues, Matrices, Computational Mathematics, System Stability, Principal Component Analysis, Engineering Applications, Data Science, Applied Mathematics

