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**An Investigation of Fixed-Point Theory and Its Different
Operations**

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Abstract

Fixed point theory is a significant branch of mathematical analysis concerned with the study of points that remain invariant under a given mapping or operator. Over the years, it has become an essential mathematical tool for investigating the existence, uniqueness, and approximation of solutions to a wide range of nonlinear problems. This paper presents a systematic investigation of fixed-point theory with emphasis on different operations, mapping structures, and contraction conditions that influence fixed point results. Fundamental concepts associated with metric spaces, complete spaces, contraction mappings, and nonlinear operators are examined to establish the mathematical foundation of the study. Classical principles, particularly the Banach contraction principle, are discussed along with generalized approaches involving weak contractions, cyclic mappings, multivalued mappings, and other nonlinear transformations. The role of iterative procedures in obtaining approximate fixed points is also explored, with attention to their convergence and applicability. Various examples are considered to illustrate how different operations and mapping conditions affect the existence and uniqueness of fixed points. The study further highlights the relevance of fixed-point methods in differential and integral equations, optimization, numerical analysis, dynamical systems, and mathematical modelling. By bringing together classical and generalized approaches, the paper provides a broader perspective on the development and application of fixed-point theory. The findings emphasize the continuing importance of fixed-point techniques for addressing complex nonlinear problems in both theoretical and applied mathematics.

Keywords: Fixed Point Theory, Fixed Point, Mapping, Contraction Mapping, Metric Space, Nonlinear Operator, Banach Contraction Principle, Iterative Methods, Multivalued Mapping, Cyclic Mapping.