This study explores a multi-parameter, complex, and dynamic system of phage-bacteria interactions. A mathematical model based on a system of first-order delay differential equations is explored.The model integrates the evaluation of key factors that determine the population dynamics of both bacteriophages and bacteria. Particular emphasis is placed on understanding how different parameters influence the behavior and stability of the system.

The nature of the phage-bacteria system in phase space is studied. The shapes of the trajectories are analyzed, and the system's stability properties are examined. The model is solved numerically using MATLAB, as an analytical solution is practically unattainable.

A central focus of the research is the analysis of temperature as a critical factor. Temperature is considered one of the key variables affecting the physiological processes of both phages and bacteria. A series of simulations were conducted under different temperature conditions to investigate how the dynamics of the phage-bacteria system change in response to temperature increases or decreases.

The results demonstrate that under certain temperature thresholds, the system can transition into a stable coexistence regime, while in other conditions, it leads to the complete elimination of the bacterial population. Each of these scenarios reflects specific biological and physiological mechanisms, which are discussed and analyzed in detail throughout the study.