

# **Mathematical Analysis of Epidemiological Models: SIR, SIRS, and SIS Differential Equations, Stability Theory, and Bifurcation Analysis**

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This work presents a comprehensive mathematical analysis of three fundamental compartmental epidemiological models: SIR (Susceptible-Infectious-Recovered), SIRS (Susceptible-Infectious-Recovered-Susceptible), and SIS (Susceptible-Infectious-Susceptible). The analysis is developed within a rigorous functional analytic framework, examining the models through the lens of differential equations theory, stability analysis, and bifurcation theory.