

Problem 1. Consider a one-dimensional mechanical system described by the Lagrangian

$$L = \cosh x (\dot{x}^2 - 1).$$

Find the equilibrium point(s) of the system and determine the frequency of small oscillations about the stable equilibrium.

Problem 2. Find the general solution to the equation

$$\ddot{x} + \omega^2 x = \frac{f}{m} \cos(\gamma t + \beta)$$

when resonance occurs. Here f, γ and β are constants.

Problem 3. Find the solution of the nonlinear equation via the series of successive approximations

$$\ddot{x} + 2x = 3x^2$$