Model of fractional heat conduction in a thermoelastic thin slim strip with temperature-dependent thermal conductivity and thermal shock

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May 5, 2020

Abstract

In this work, the fractional order thermoelasticity theory is used to investigate the thermoelastic problem of a thin slim strip considering the thermal conductivity is to be variable. The theory of thermal stresses based on the heat conduction equation with the Caputo time-fractional derivative of order α is used. The surface of the strip is subjected to a thermal shock and assumed to be traction free. By using the Laplace transform and numerical Laplace inversion, the governing equations are solved. The inverse of the Laplace transform is done numerically using a method based on Fourier expansion techniques. Numerical calculations for the considered variables are performed and the results obtained have been presented graphically. The effects of fractional order parameter and the variation of thermal conductivity on temperature, stress, and displacement are investigated.

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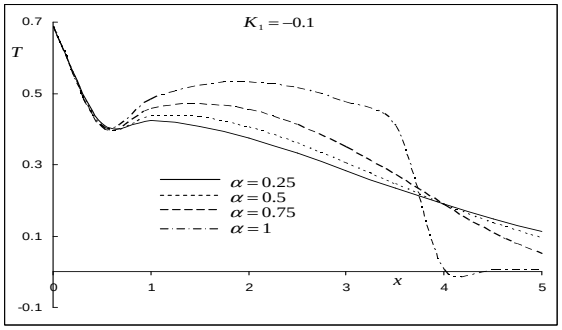

Figure1: The effect of fractional order parameter on temperature distribution

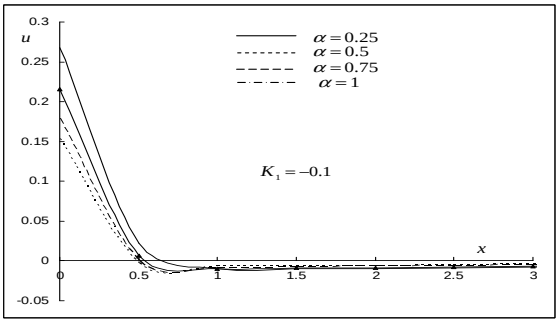

Figure2: The effect of fractional order parameter on displacement distribution

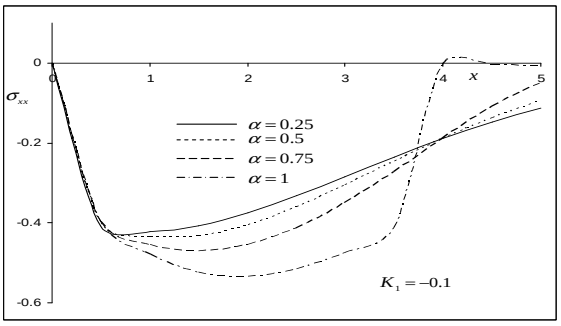

Figure 3: The effect of fractional order parameter on stress distribution