In this work, we consider the one-dimensional problem for an infinitely long solid cylinder in the context of the theory of generalized thermoelasticity with one relaxation time. The heat conduction equation with the Caputo fractional derivative of order α is used. The curved surface of the cylinder is assumed to be in contact with a rigid surface and is subjected to constant heat flux. By means of the Laplace transform and numerical Laplace inversion the problem is solved. Numerical computations for the temperature, displacement and stress distributions are carried out and displayed graphically as well as the results are discussed comprehensively.