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q-damped Oscillator and degenerate roots of constant coefficients q-difference ODE

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The classical model of q-damped oscillator is introduced and solved in terms of Jackson q-exponential function for three different cases, under-damped, over-damped and the critical one. It is shown that in all three cases solution is oscillating in time but is unbounded and non-periodic. By q-periodic function modulation, the self-similar micro-structure of the solution for small time intervals is derived. In the critical case with degenerate roots, the second linearly independent solution is obtained as a limiting case of two infinitesimally close roots. It appears as standard derivative of q-exponential and is rewritten in terms of the q-logarithmic function. We extend our result by constructing n linearly independent set of solutions to a generic constant coefficient q-difference equation degree N with n degenerate roots.

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