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Polynomials of the Higher Derivatives of the Nield-Kuznetsov Integral Function

M.H. Hamdan and T.L. Alderson Abstract Airy's functions of the first and second kinds represent two linearly independent solutions to the homogeneous Airy's equation. Airy's polynomials arise when one considers higher derivatives of Airy's functions or derivatives of their products. Airy's functions and associated polynomials are of importance in the study of circuit theory, systems theory and signal processing and arise in solutions to Stark, Schrodinger, and Tricomi's equations. Many differential equations in quantum theory can be reduced to Airy's equation by an appropriate change of variables, thus adding to the importance of studies of Airy's and related functions.

The inhomogeneous Airy's equation has been shown to have a particular solution expressible in terms of the Nield-Kuznetsov integral function, defined in terms of Airy's functions and their integrals. Associated with higher derivatives of the Nield-Kuznetsov function are three sets of polynomials of non-equal degrees that are functions of the order of the derivative involved. Two of the arising sets of polynomials are Airy's polynomials, while the third set arises from coefficients of the Wronskian of Airy's functions. This Wronskian appears in the Nield-Kuznetsov function and its derivatives. Our objective are: 1) Analyze the Nield-Kuznetsov polynomials and express them in terms of the Nield-Kuznetsov first derivative. 2) Implement the resulting polynomials in expressing the Nield-Kuznetsov function in terms of Bessel functions. 3) Derive ascending series and asymptotic series expressions of the Nield-Kuznetsov function in terms of arising polynomials and use them in computations of these functions.