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Foupouagnigni, M.; Koepf, W.; Ronveaux, A.

Fourth-order difference equation for the associated classical discrete orthogonal polynomials. (English)

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Let $\{P_n(x)\}_n$ be the sequence of the monic orthogonal polynomials satisfying the recurrence $P_{n+1}(x) = (x - \beta_n)P_n(x) - \gamma_n P_{n-1}(x)$, $n \geq 1$, $\gamma \neq 0$, $P_0(x) = 1$, $P_1(x) = x - \beta_0$. The associated orthogonal polynomials $P_n^{(r)}(x)$ of order r are defined by the shifted recurrence obtained by substituting n with $n + r$ in β and γ. In this paper the authors give a fourth-order difference equation which holds for all integer r and for all classical discrete orthogonal polynomials. The coefficients of this equation are given in terms of the polynomials $\sigma(x)$ and $\tau(x)$ which appear in the second-order difference equation $\sigma(x)\nabla\Delta y(x) + \tau(x)\Delta y(x) + \lambda_n y(x) = 0$, with $\Delta y(x) = y(x + 1) - y(x)$, $\nabla u(x) = y(x) - y(x - 1)$ and $2\lambda_n = -n[(n - 1)\sigma'' + 2\tau']$.

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- 33C45 Orthogonal polynomials and functions of hypergeometric type