Mathematics > Classical Analysis and ODEs

Some integrals and series involving the Gegenbauer polynomials and the Legendre functions on the cut (-1,1)

Radosław Szmytkowski

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We use the recent findings of Cohl [arXiv:1105.2735] and evaluate two integrals involving the Gegenbauer polynomials: $\int_{-1}^{x}\mathrm{d}t\:(1-t^{2})^{\lambda-1/2}(x-t)^{-\kappa-1/2}C_{n}^{\lambda}(t)$ and $\int_{x}^{1}\mathrm{d}t\:(1-t^{2})^{\lambda-1/2}(t-x)^{-\kappa-1/2}C_{n}^{\lambda}(t)$, both with $\Real\lambda>-1/2$, $\Real\kappa<1/2$, $-1<x<1$. The results are expressed in terms of the on-the-cut associated Legendre functions $P_{n+\lambda-1/2}^{\kappa-\lambda}(\pm x)$ and $Q_{n+\lambda-1/2}^{\kappa-\lambda}(x)$. In addition, we find closed-form representations of the series $\sum_{n=0}^{\infty}(\pm)^{n}[(n+\lambda)/\lambda]P_{n+\lambda-1/2}^{\kappa-\lambda}(\pm x)C_{n}^{\lambda}(t)$ and $\sum_{n=0}^{\infty}(\pm)^{n}[(n+\lambda)/\lambda]Q_{n+\lambda-1/2}^{\kappa-\lambda}(\pm x)C_{n}^{\lambda}(t)$, both with $\Real\lambda>-1/2$, $\Real\kappa<1/2$, $-1<t<1$, $-1<x<1$.

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