Generalized Bernoulli Polynomials via the Residue Theorem

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We define a class of functions based on the form of the generating function of the generalized Bernoulli polynomials and pose a question of finding the residue of such functions at zero. We are able to give an answer as a closed form that involves multiple sums of the harmonic numbers.

We present an application of such formulas in giving a closed form of the generalized Bernoulli polynomials $B_n^{(a)}(x)$ where a and n are nonnegative integers with $a \geq n+2$. We also discuss recent developments to obtain further interesting identities.

[1] Aram Tangboonduangjit, "Residues (at Zero) of Functions Related to Ones Generating the Generalized Bernoulli Polynomials", East-West J. of Mathematics, 166-177 (2010).