Polynomial identities satisfied by generalized polynomials

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Abstract. The main purpose of this paper is to solve polynomial equations that are satisfied by (generalized) polynomials. More exactly, we deal with the following problem: let $\mathbb{F}$ be a field with $\mathrm{char}(\mathbb{F}) = 0$, and let $P \in \mathbb{F}[x]$ and $Q \in \mathbb{C}[x]$ be polynomials. Our aim is to prove characterization theorems for generalized polynomials $f \colon \mathbb{F} \to \mathbb{C}$ of degree two that also fulfill the equation

$$f(P(x)) = Q(f(x))$$

for each $x \in \mathbb{F}$. As it turns out, the difficulty of such problems heavily depends on that we consider the above equation for generalized polynomials or for (normal) polynomials. Therefore, firstly we study the connection between these two notions.

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