Vector valued polynomials, exponential polynomials and vector valued harmonic analysis

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Let G be a topological Abelian semigroup with unit, and let E be a Banach space. We define, for functions mapping G into E, the classes of polynomials, exponential polynomials and some other relevant classes. We establish their connections with each other and find their representations in terms of the corresponding complex valued classes.

We also investigate spectral synthesis and analysis in the class $C(G, E)$ of continuous functions $f\colon G \to E$. We show that if G is an infinite and discrete Abelian group and E is a Banach space of infinite dimension, then even spectral analysis fails in $C(G, E)$. We also prove that if G is discrete, has finite torsion free rank and if E is a Banach space of finite dimension, then spectral synthesis holds in $C(G, E)$.