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Polynomial identities and reducibility

Let S be a (multiplicative) semigroup of operators satisfying a polynomial identity in two variables, i.e., assume that there is a noncommutative polynomial $f(x, y)$ such that $f(A, B) = 0$ for all A and B in S. We consider the following question. Under what conditions does this hypothesis imply the existence of a nontrivial invariant subspace for S? The best known example of an affirmative answer to this question is in the case where $f(x, y) = xy - yx$, and S contains a nonzero compact operator. On the other hand, it is also well known that there are polynomials that are identically zero on the whole algebra of operators acting on a finite-dimensional space. We discuss some affirmative answers and present tests for polynomials having reducing and triangularizing properties.