1. Let $V = L(\mathbb{R}^{2006}, \mathbb{R}^2)$ be the vector space of linear transformations from $\mathbb{R}^{2006}$ to $\mathbb{R}^2$ and let $v_0 \in \mathbb{R}^{2006}$ be a nonzero vector. Define a linear transformation $E : V \to \mathbb{R}^2$ by $E(T) = T(v_0)$. Find $\dim(\ker E)$.

2. Suppose that $T \in L(V)$ is a linear operator on the $n$-dimensional vector space $V$. Let $W$ be the subspace of $L(V)$ spanned by $\{I, T, T^2, \ldots\}$. Prove that $\dim(W) \leq n$.

3. Suppose that $V$ is a complex vector space of dimension 5, $T \in L(V)$ is nilpotent, and $\dim(\ker T) = 2$. Find all possible minimal polynomials of $T$ and the corresponding Jordan canonical forms of $T$.

4. Suppose that $V$ is a real finite dimensional inner-product space and that $W$ is a subspace of $V$. Let $T : V \to V$ be the orthogonal projection onto $W$. Prove that $T$ is self-adjoint.