1.   True or False?

There exists $T \in \mathcal{L}(\mathbf{R}^2)$ such that $T^4 = -1$.

2. True or False?

Suppose $T \in \mathcal{L}(V)$ is such that $T^2 v = 4v$ for all $v \in V$. Then $T = 2I$ or $T = -2I$.

3.   True or False?

Suppose V is an n-dimensional complex vector space and $T \in \mathcal{L}(V)$. Then there exists a k-dimensional subspace of V invariant under T for all $k = 0, 1, \ldots, n$.