#6(d) We will prove this by induction on $n = \dim V$.

Base case: $n = 1$

This is trivial.

Induction step: Assume that for every $(n-1)$-dim'l i.p. space $\tilde{V}$ and every normal linear transformation $\tilde{T} : \tilde{V} \to \tilde{V}$, there is an o.n. basis for $\tilde{V}$ consisting of eigenvectors for $\tilde{T}$.

Since we are working over $\mathbb{C}$, the char. poly. of T splits and so $\exists$ an eigenvector $v \in V$ for T. Let $W = \operatorname{span}\{v\}$.

W is T-invariant $\Rightarrow$ $W^\perp$ is T^*-invariant (from class)

W is also T^*-invariant, since v is an eigenvector for T^* (by (c)), so $W^\perp$ is T^{**}-invariant

$\Rightarrow$ $W^\perp$ is T-invariant.

Let $\tilde{V} = W^\perp$ and $\tilde{T} = T|_{W^\perp}$.

$\tilde{V}$ is an $(n-1)$-dim'l inner product space, and