Proof :

Take v, and expand it into

a basis of V,

$v, u_1, \cdots, u_m$.

Define dual basis $\varphi, \varphi_1, \cdots, \varphi_m$.

as per Axler's 3.96,

where $\varphi(v_k) = \begin{cases} 1 & \text{if } v_k = v \\ 0 & \text{otherwise} \end{cases}$