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Ans 3.

$$\|Au\|^2 = \langle Au, Au\rangle = u^{+}A^{+}Au$$
$$= \langle u, A^{+}Au\rangle$$
$$= \langle u, u\rangle$$
$$= \|u\|^2$$

$$\therefore \|Au\|^2 - \|u\|^2 = \langle u, A^{T}Au\rangle - \langle u, u\rangle$$
$$= \langle u, (A^{T}A - I)u\rangle = 0$$

for all $u \in V$

$\Rightarrow A^{T}A = I$, similarly can be shown that $AA^{T} = I$

$$\|Au\|^2 = \langle Au, Au\rangle = \langle u, A^{T}Au\rangle$$
$$= \langle u, u\rangle = \|u\|^2$$
$$[A^{T}A = I]$$

$$\|Au\| = \|u\|$$