Assignment 2

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1) **Solution:**

$$A = \begin{pmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{pmatrix} \quad (1)$$

$$\implies A^T = \begin{pmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{pmatrix} \quad (2)$$

$$\begin{pmatrix} a_1 \\ a_2 \end{pmatrix} = \begin{pmatrix} a_1 & -a_2 \\ a_2 & a_1 \end{pmatrix}\begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad (3)$$

$$i.e \ A = \begin{pmatrix} \cos\alpha \\ -\sin\alpha \end{pmatrix} \quad (4)$$

$$\implies A = e^{-j\alpha} \quad (5)$$

$$i.e. \ A^T = \begin{pmatrix} \cos\alpha \\ \sin\alpha \end{pmatrix} \quad (6)$$

$$\implies A^T = e^{j\alpha} \quad (7)$$

$$\implies A^T A = e^{j\alpha}e^{-j\alpha} = 1 \quad (8)$$

$$\implies A^T A = I \quad (9)$$

2) **Solution:**

$$A = \begin{pmatrix} \sin\alpha & \cos\alpha \\ -\cos\alpha & \sin\alpha \end{pmatrix} \quad (10)$$

$$\implies A^T = \begin{pmatrix} \sin\alpha & -\cos\alpha \\ \cos\alpha & \sin\alpha \end{pmatrix} \quad (11)$$

Using (3),

$$i.e \ A = \begin{pmatrix} \sin\alpha \\ -\cos\alpha \end{pmatrix} \quad (12)$$

$$\implies A = e^{-j(\frac{n\pi}{2}-\alpha)} \quad (13)$$

$$A^T = \begin{pmatrix} \sin\alpha \\ \cos\alpha \end{pmatrix} \quad (14)$$

$$\implies A^T = e^{j(\frac{n\pi}{2}-\alpha)} \quad (15)$$

$$\implies A^T A = e^{j(\frac{n\pi}{2}-\alpha)}e^{-j(\frac{n\pi}{2}-\alpha)} = 1 \quad (16)$$

$$\implies A^T A = I \quad (17)$$

Here, n in (13) and (15) is an odd number.

Hence proved for both Problems 1 and 2.