Assignment 1

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Assignment 2

Problem 2.1

Solution: Given,

$$A = \begin{pmatrix} \cos\alpha & \sin\alpha \\ \text{-}\sin\alpha & \cos\alpha \end{pmatrix} \quad A^T = \begin{pmatrix} \cos\alpha & \text{-}\sin\alpha \\ \sin\alpha & \cos\alpha \end{pmatrix} \tag{1}$$

We have to prove that $A^T A = $ I (Identity matrix)

LHS:

$$A^T A = \begin{pmatrix} \cos\alpha & \text{-}\sin\alpha \\ \sin\alpha & \cos\alpha \end{pmatrix} \begin{pmatrix} \cos\alpha & \sin\alpha \\ \text{-}\sin\alpha & \cos\alpha \end{pmatrix} \tag{2}$$

$$= \begin{pmatrix} \cos^2\alpha + \sin^2\alpha & \cos\alpha\sin\alpha - \sin\alpha\cos\alpha \\ \sin\alpha\cos\alpha - \cos\alpha\sin\alpha & \sin^2\alpha + \cos^2\alpha \end{pmatrix} \tag{3}$$

$$= \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \tag{4}$$

$$= I \tag{5}$$

RHS:

$$I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \tag{6}$$

Therefore, **LHS = RHS** i.e. A^TA = I

Hence Proved.

Problem 2.2

Solution: Given,

$$A = \begin{pmatrix} \sin\alpha & \cos\alpha \\ \text{-}\cos\alpha & \sin\alpha \end{pmatrix} \quad A^T = \begin{pmatrix} \sin\alpha & \text{-}\cos\alpha \\ \cos\alpha & \sin\alpha \end{pmatrix} \tag{7}$$

We have to prove that $A^T A = \text{I}$ (Identity matrix)

LHS:

$$A^T A = \begin{pmatrix} \sin\alpha & \text{-}\cos\alpha \\ \cos\alpha & \sin\alpha \end{pmatrix} \begin{pmatrix} \sin\alpha & \cos\alpha \\ \text{-}\cos\alpha & \sin\alpha \end{pmatrix} \tag{8}$$

$$= \begin{pmatrix} \sin^2\alpha + \cos^2\alpha & \sin\alpha\cos\alpha - \cos\alpha\sin\alpha \\ \cos\alpha\sin\alpha - \sin\alpha\cos\alpha & \cos^2\alpha + \sin^2\alpha \end{pmatrix} \tag{9}$$

$$= \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \tag{10}$$

$$= I \tag{11}$$

RHS:

$$I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \tag{12}$$

Therefore, **LHS = RHS** i.e. $A^T A = \text{I}$

Hence Proved.