EE2302 Foundations of Information Engineering

Assignment 8 **Due: 11 pm, Nov 1**

Full Mark: 16 points

1. (4 marks) The set of all 2×2 real matrices in the form of $A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$ is a vector space. Consider the subset of 2×2 real matrices which satisfy $a_{12} = -a_{21}$. Does it form a subspace? Prove or disprove it.

2. (4 points) Determine whether each of the following scalar-valued functions n-vectors is linear. If it is linear, give its inner product representation, i.e., an n-vector a for which $f(x) = a^T x$ for all x. If it is not linear, give specific x, y, α, β for which superposition fails, i.e.,
$$f(\alpha x + \beta y) \neq \alpha f(x) + \beta f(y).$$
   a) $f(x) = \max_k x_k$
   b) $f(x) = x_n - x_1$

3. (4 points) What 3 by 3 matrices represent the transformations that
   a) reflect every vector through the x-y plane?
   b) rotate the x-y plane through 90^o, leaving the z-axis alone?

4. (4 points) Consider the 2-dimensional space and the projection of b on the line passing through the origin and a, where $a = (10, 10)$.
   a) Determine the corresponding projection matrix P.
   b) Suppose $b = (3, 5)$. Determine the result after the projection.