Due Date: Wednesday, September 13th, at the BEGINNING of the lecture

**INSTRUCTIONS:** Please write your work on a separate paper, and attach this page with your name to the top. Make sure to show all your work. Please keep the copy of your work for yourself so that you can check your answers.

For problems 1–13 use vectors \( \mathbf{u} = \begin{bmatrix} 1 \\ -1 \\ \sqrt{2} \\ 4 \\ \sqrt{5} \\ 0 \end{bmatrix} \), and \( \mathbf{v} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \\ 0 \\ \sqrt{2} \end{bmatrix} \) in \( \mathbb{R}^6 \).

1) Find \(-3\mathbf{v} + 2\mathbf{u}\)
2) Find \(\mathbf{u} \cdot \mathbf{v}\).
3) Find \(||\mathbf{u}||\) and \(||-2\mathbf{v}||\)
4) Find 2 unit vectors parallel to \(\mathbf{u}\).
5) Normalize vector \(\mathbf{v}\).
6) Find the vector of length 5 which has the same direction as \(\mathbf{v}\).
7) Find the angle between \(\mathbf{u}\) and \(\mathbf{v}\).
8) Give an example on any non-zero vector, orthogonal to \(\mathbf{u}\).
9) Check that the Cauchy-Schwarz Inequality holds for vectors \(\mathbf{u}\) and \(\mathbf{v}\).
10) Check that the Triangle Inequality holds for vectors \(\mathbf{u}\) and \(\mathbf{v}\).
11) Check that the Pythagorean Theorem DOES NOT hold for vectors \(\mathbf{u}\) and \(\mathbf{v}\).
12) Find the distance between \(\mathbf{u}\) and \(\mathbf{v}\).
13) a) Find \(\text{proj}_\mathbf{a}\mathbf{v}, \text{proj}_\mathbf{v}\mathbf{u}, \text{perp}_\mathbf{a}\mathbf{v}, \text{and} \text{perp}_\mathbf{v}\mathbf{u}\).
   b) Check that \(\text{proj}_\mathbf{a}\mathbf{v} \perp \text{perp}_\mathbf{a}\mathbf{v}\) and \(\text{proj}_\mathbf{v}\mathbf{u} \perp \text{perp}_\mathbf{v}\mathbf{u}\).
14) Find \(||\mathbf{a} + \mathbf{b}||\), if \(||\mathbf{a}|| = 2, \ ||\mathbf{b}|| = 3, \) and \(\mathbf{a} \cdot \mathbf{b} = -1\)
15) Show that there are no vectors \(\mathbf{a}\) and \(\mathbf{b}\), such that \(\mathbf{a} \cdot \mathbf{b} = 3, \ ||\mathbf{a}|| = \sqrt{3}\), and \(||\mathbf{b}|| = \sqrt{2}\).
16) Find normal and parametric equations of the line in \(\mathbb{R}^2\) passing through the points \((-1, 2)\) and \((2, -1)\).
17) Find parametric equations of the plane containing the point \(A = (2, 5, -13)\) and the line \(x = 1 - t, \ y = 4, \ z = 3t + 5\).
18) Find the distance from the point \(A = (4, 2, -5)\) to the line \(x = 1, \ y = 3 - 2t, \ z = 3t - 2\). DO NOT SIMPLIFY your answer.
19) Find the distance from the point \(B = (-2, 5, 7)\) to the plane \(x - 2y + 5z = 6\).