Problem 1: Redo the problems you failed or where unclear in Quiz 1, according to grading. All answers must be worked out *neatly* until a reasonably simplified form is reached. You should work out your solutions individually. You are not allowed to write in the test. All work must be handed in separate sheets. If you have any doubts, ask your instructor.

Problem 2: In the network shown below, all branch voltages $v_1, v_2, \ldots, v_5$ can be expressed as differences of node voltages $e_1, e_2$ and $e_3$.

(A) Find the equations that relate each branch voltage to the node voltages $e_1, e_2$ and $e_3$. Cast the equations in matrix form such that

$$
\begin{bmatrix}
v_1 \\
v_2 \\
v_3 \\
v_4 \\
v_5
\end{bmatrix}
= A^T
\begin{bmatrix}
e_1 \\
e_2 \\
e_3
\end{bmatrix}
$$

where $A^T$ is a matrix whose elements are only 1, 0, and -1.
(B) Show that KVL is satisfied with the previous equation by computing the following sums of voltages around closed loops:

(i) \( v_1 + v_4 - v_2 = \)

(ii) \( v_2 + v_5 - v_3 = \)

(iii) \( v_1 + v_4 + v_5 - v_3 = \)

(C) Evaluate \((A^T)^T i = A i\), where \( i = [i_1 \ i_2 \ i_3 \ i_4 \ i_5]^T \) using KCL.

(D) Show that \( v^T i = 0 \) by direct substitution of \( v = A^T e \) and \( i = [i_1 \ i_2 \ i_3 \ i_4 \ i_5]^T \).