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**Systems of equations in Engineering: The Two – Loop Circuit Physical Lab**

**Abstract:**

By the execution of The Two-Loop Circuit, our goal was to learn the basics of systems of equations and matrices and their application in Engineering. In order to prove this, we measured the current of four resistors in a circuit built in parallel and in series. The results were gotten from three different methods: The substitution method, Matrix Inverse and by Cramer’s Rule.

First, we had to measure the values of each resistor; R1 and R2 had a resistance of 1000 ohms, while R3 and R4 a resistance of 200 ohms. After getting these values, we proceeded to measure the First Current (I1) by setting the power supply on different volts values, to be specific, with 5V, 7V, 9V and 11V. It is important to highlight that the final value of the current must be in Amps.

Once the First Resistance is measured, the same process is made for the second (I2 ), but this time, the cables must be interchanged. The values should also be in Amps. The chart should look like this. Now that the data had been collected, we could proceed and check by the three methods that what we did, was right.

For the system of equations, we write equation one and two with a variable of I1 and I2, the right part of the equation is written by the number of voltages that it is asked to do, in this case, voltage 7 and 0. By having this data, the chart should look like this.

1. 2000 I1  - 1000 I2 = 7
2. -1000 I1  + 1400 I2 = 0

|  |  |  |
| --- | --- | --- |
| **Vs (Volts)** | **I1 Amps** | **I2 Amps** |
| **5** | 0.0039 | 0.0028 |
| **7** | 0.0055 | 0.0038 |
| **9** | 0.007 | 0.0052 |
| **11** | 0.0086 | 0.0062 |

Now we follow the procedure to solve it for the resistance values:

For the first method, it does not matter which variable is substituted, it should get to the same answer, after isolating I1 or I2, the value is later on place on the other equation and solve for the opposite variable. By doing this, we should have the values for each variable. These could be used as reference for proving the following methods. For the next method, the Matrix Algebra one, we should order and write three matrixes. In this case we used A for the values of the equations, also known as coefficients, then for the X matrix, we should write the variables that are being solved in the system of equations, I1 and I2. Finally for the Y matrix, we write the values after the “=” sign.

By having these matrixes written, we calculate the determinant by cross multiplying the values of the matrix A. Later on, we divide the inverse of A by the determinant and got the values for the A’. Finally, we multiply the inverse matrix times the Y one, this being the path for our final answer I1 and I2.

For the last method, we use Crammer’s Rule, in it we basically write the same matrixes, A, X, Y, get the determinant and later on we substitute the values of Y in the original A matrix, the substitution must be for each column, it means that only one column will maintain the original values while the other one changes, they are alternated. After this, we divide the values by the determinant and this is how we get I1 and I2.



