***3.1. - Theoretical frame:***

***3.1.1. –Nodal Analysis:*** In electric circuits analysis, nodal analysis, node-voltage analysis, or the branch current method is a method of determining the voltage (potential difference) between "nodes" (points where elements or branches connect) in an electrical circuit in terms of the branch currents.

Nodal analysis is possible when all the circuit elements' branch constitutive relations have an admittance representation. Nodal analysis produces a compact set of equations for the network, which can be solved by hand if small, or can be quickly solved using linear algebra by computer.

The steps in the nodal analysis method are:

1. Count the number of principal nodes or junctions in the circuit. Call this number n. (A principal node or junction is a point where 3 or more branches join. We will indicate them in a circuit diagram with a red dot. Note that if a branch contains no voltage sources or loads then that entire branch can be considered to be one node.)
2. Number the nodes N1, N2, ..., Nn and draw them on the circuit diagram. Call the voltages at these nodes V1, V2, . . . , Vn, respectively.
3. Choose one of the nodes to be the reference node or ground and assign it a voltage of zero.
4. For each node except the reference node write down Kirchhoff’s Current Law in the form "the algebraic sum of the currents flowing out of a node equals zero". (By algebraic sum we mean that a current flowing into a node is to be considered a negative current flowing out of the node.)
5. The result, after simplification, is a system of m linear equations in the m unknown nodal voltages (where m is one less than the number of nodes; m = n - 1). The equations are of this form:

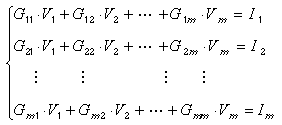


Figure 3.1.1 Example of a equation system

Solve the system of equations for the m node voltages V1, V2, . . . , Vm using Gaussian elimination or some other method.

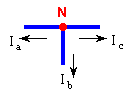


Figure 3.1.2

Example of nodal analysis.

The aim of nodal analysis is to determine the voltage at each node relative to the reference node (or ground).

***Conclusion:***

After we finished this practice we learned the way a nonlinear circuit can be calculated, due to the fact that if we did it by the traditional method then we wouldn’t be able to get it in a quicker and efficient way, but the nodal analysis showed us how easy it can be to analyze this type of circuits.

***Questionnaire;***

1. - A node is the point of connection between two or more branches. Node is indicated by dot sign. When a short circuit has two nodes it actually becomes one node. If we redraw the first circuit as it has two common points shown in black color filled.
2. The node voltage method of analysis solves for unknown voltages at circuit nodes in terms of a system of KCL equations. This analysis looks strange because it involves replacing voltage sources with equivalent current sources.
3. The reference node also called ground and define the other node voltages with respect to this point. The reference node has a potential of 0V by definition.
4. It uses the branches in the circuit to determine certain data and how it works inside the circuit, it is possible when all the circuit elements' branch constitutive relations have an admittance representation.
5. Electric power is the rate, per unit time, at which electrical energy is transferred by an electric circuit. The SI unit of power is the watt, one joule per second.

***Bibliography:***

Nodal Analysis of Power Systems Abacus Press Kent 1975

<http://www.electronics-tutorials.ws/dccircuits/dcp_6.html>

<http://www.ee.ic.ac.uk/hp/staff/dmb/courses/ccts1/00300_Nodal.pdf>