NANENG 4340 Final Assessment Report

No doubt that it is very difficult to define voltages and currents for non-TEM lines. In addition, a practical problem exists when trying to measure voltages and currents at microwave frequencies because direct measurements usually involve the magnitude (inferred from power) and phase of a wave traveling in a given direction or of a standing wave. Thus, equivalent voltages and currents, and the related impedance and admittance matrices, become somewhat of an abstraction when dealing with high-frequency networks. A representation more in accord with direct measurements, and with the ideas of incident, reflected, and transmitted waves, is given by the scattering matrix.

Like the impedance or admittance matrix for an N-port network, the scattering matrix provides a complete description of the network as seen at its N ports. While the impedance and admittance matrices relate the total voltages and currents at the ports, the scattering matrix relates the voltage waves incident on the ports to those reflected from the ports. For some components and circuits, the scattering parameters can be calculated using network analysis techniques. Otherwise, the scattering parameters can be measured directly with a vector network analyzer.

Each student individually is required to prepare a report for at least 5 pages about the scattering matrices and scattering parameters of microwave circuits. The report must cover the following parts:

1. Clear and comprehensive definition of scattering parameters with the aid of equations and figures.
2. The relation between scattering, impedance and admittance matrices for the same network showing the importance and significance of scattering parameters especially in case of microwave networks.
3. Explain how to define different network properties (Lossless or lossy, matched or not, and reciprocal or not) from the scattering matrix of the network.
4. Mention and describe the analysis and operation of two different multiport microwave circuits by showing how to get their scattering matrices. Multiple examples for 3-ports and 4-ports microwave networks (that you can use in your

report) can be found in the course book (Microwave Engineering) in chapter 7: Power Dividers and Directional Couplers.

- **Notes:**
  - The report must be submitted as a single PDF file to Google classroom site before the deadline.
  - The report will be checked for plagiarism and a penalty of (- 50 %) will be applied for those who have a percentage greater than 30 %.