

## **What is the state in which conservative systems consume less power or energy?**

*Prof. Horia ANDREI, SM-IEEE University Valahia Targoviste, Romania*  
hr\_andrei@yahoo.com

**Abstract.** Answering the question “what is the state in which conservative systems consume less power or energy?” is fundamental. Therefore, multitudinous studies have been carried out to formulate the steady-state of many domains such as physical sciences (mechanics, thermodynamics, electromagnetic), chemistry, life science (hydrology, meteorology, global climate) in power or energy terms. Based on the variational principles in these studies specific functionals expressed in terms of power or energy, are defined. In previous works, the author have chosen the potentials of nodes as variables whereas utilizing the matrix equation of the circuits. Further by imposing the minimization conditions of the power functionals is obtained the first Kirchhoff’s law.

Advanced numerical analysis is proposed to find the extreme point of power or energy functionals for electric and magnetic circuits in the quasi-stationary state. Lagrange multipliers and the variational method in Hilbert space have demonstrated the existence of the minimum of the functionals. The power flow in equilibrium conditions when the DC and AC circuit consumes minimum power, considering all classical powers (active and reactive) is discussed.

Several examples implemented in PSPICE prove the theoretical principles of minimum consumed power (PMCP). It also shows that the transient regime of an electric circuit represents its passage between two quasi-stationary states with minimum power consumption and the co-existence of the fundamental theorem of maximum power transfer and the PMCP.

Based on the analogy between the linear magnetic circuits and electric circuits the minimum principle of consumed energy (PMCE) for magnetic circuits in the quasi-stationary state is presented. Several examples prove the theoretical principle formulates and put in evidence the applicability of this principle to the calculation of the energy and forces in electromagnetic types of equipment.

In conclusion, as a theoretical point of view, it is noted that the proposed principles together with the second Kirchhoff’s law establish a complete equation system for DC and AC electric respectively magnetic circuits in the quasi-stationary state. On the other hand, from a practical point of view, the principles of minimum consumed power are very useful for the understanding of the power and energy flow in electric and magnetic systems.