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Abstract:
Studies of load flow, short circuit, and stability are classical problems of power engineering. They must be solved for the expansion planning and operation planning of electrical power transmission networks. Networks for electric power transmission consist of many network regions with different voltage levels, which are magnetically coupled through different kinds of transformers: two-winding transformers, three-winding transformers, three-winding auto-transformers, and phase shifting transformers. Calculations involving electric power transmission networks are not an easy task.
This work addresses the conceptual aspect of the mathematical modeling of two-winding transformers in power engineering. It attempts to simplify for the electrical engineering student the understanding of how to perform the calculations of these transformers in the network, both in physical units and in the per-unit system.
Presented first are the main features of regulating transformers. Two of the three essential parameters are then explained, namely the open circuit admittance and the short circuit impedance, with which is constructed the base equivalent π-circuit of the two-winding transformer. The third essential parameter, which is the complex ratio of transformation, is developed step by step. With the preceding information, four possible models are generated for the two-winding transformer. One of these models is selected to develop the main topics of this work, which are: voltage equation systems in physical units, the transition of these equations toward the voltage equation system expressed in the per-unit system, and the method of interchange between the variables of a linear equations system applied to the voltage equations system. This method leads to interesting linear equation systems which allow calculating the transformer power losses and the operating conditions in one of its terminals, when only the operating conditions in the other terminal of the transformer are known. This method is also applied to calculate the voltage regulation of the transformer directly. The numerical results show that all equation systems and expressions developed in this work are also applicable to other elements of the electrical power transmission network, such as overhead lines and underground cables.

Biography:
Washington H. Peralta was born in San Juan, Argentina in 1947. He graduated as an electromechanical engineer from the National University of Cuyo, Argentina, in 1972. He received his M.Sc. in 1980 and his Ph.D. in 1991 from the University of Erlangen-Nürnberg, Germany. He received a scholarship from the German Academic Interchange Service (June, 1978 - December, 1980) and a scholarship from the Alexander von Humboldt Foundation (March, 1987- February, 1989). He was hired by the German Research Foundation in the period March 1989 to February 1991. From October 1991 to December 1993 he was a Senior Electrical Engineer at “Centro Elettrotecnico Sperimentale Italiano (CESI)”, in Milan, Italy, where he participated in software development for an Operator Training Simulator. In the period
1986-2014 he worked as Professor of Electrical Power Systems at the Institute of Electric Energy of the National University of San Juan in Argentina, on leave in the period 1987-1993. His current research activities focus on steady state operation and dynamical behavior of electrical power system.