This dissertation consists of two major parts: in the first one the systems to be synthesized and the elements used in the synthesis are discussed; in the second part necessary and sufficient conditions for passivity and losslessness are derived and the synthesis is presented.

So we have in Chapter 2 the discussion on how to realize nonlinear elements. In order to realize this objective, traditors and conjuctors are used and generalization of these is presented. Moreover necessary and sufficient conditions for the realization of resistive and reactive elements are obtained.

Chapter 3 presents the theory of bilinear systems. The linearization of the output equations and the concepts of reachability and observability are discussed. With these concepts minimal systems are obtained and an example given to illustrate the theory.

Chapter 4, which with Chapter 5, forms the core of the dissertation, presents necessary and sufficient conditions for passivity and losslesness of bilinear-quadratic systems. Besides this, equivalence is also presented.

Chapter 5 presents the impedance synthesis of lossless and passive bilinear-quadratic N-ports. Also the synthesis using a minimal number of conjuctors is obtained. The dual case, that is, the admittance synthesis is also given.

In the last chapter we present the conclusions and open problems that might be solved using the same line of thought.

In the appendix practical realizations of traditors and conjunctors are suggested.