In the thesis, selected procedures of fault tree analysis and their applications to system reliability analysis are described. Emphasis is placed especially on effective determination of minimal cutsets, provided coherency or monotonicity of studied fault trees. Classical ways of identifying minimal cuts and modern approaches using binary decision diagrams are presented. Precise construction of the theory of binary decision diagrams from the basic theory of Boolean algebra is covered in detail. Algorithms for finding minimal cutsets using binary decision diagrams are at first described theoretically and then they are implemented in C++ programming language.