This paper presents an improved evolutionary algorithm based on quantum computing for optimal steady-state performance of power systems. However, the proposed general quantum genetic algorithm (GQ-GA) can be applied in various combinatorial optimization problems. In this study the GQ-GA determines the optimal settings of control variables, such as generator voltages, transformer taps and shunt VAR compensation devices for optimal reactive power and voltage control of IEEE 30-bus and 118-bus systems. The results of GQ-GA are compared with those given by the state-of-the-art evolutionary computational techniques such as enhanced GA, multi-objective evolutionary algorithm and particle swarm optimization algorithms, as well as the classical primal-dual interior-point optimal power flow algorithm. The comparison demonstrates the ability of the GQ-GA in reaching more optimal solutions.