With the advance of the information and communication technology, the demand for high bit rate communication systems has been raising exponentially. For this reason, optical soliton pulse propagation in a real fiber which is the subject of this thesis, has been investigated from different points of view. In optical fibres solitons can evolve by choosing appropriate pulse and fibre parameters to obtain a counter balancing of group velocity dispersion (GVD) and self phase modulation (SPM). This research thesis provides knowledge about optical solitons in fiber with inhomogeneous effects to develop the optical fiber communication technology.

In this thesis, optical soliton propagation in nonautonomous nonlinear Schrödinger equation (NLSE), nonautonomous nonlinear Schrödinger equation with phase modulation, nonlinear tunneling of soliton in coupled NLSE with variable coefficients, the effect of various forms of external potential on soliton propagation and soliton propagation in fiber with higher order effects are investigated. In this thesis, to find the soliton solutions for few models of NLS equations, Darboux transformation technique is employed based on the Lax pair of NLS equations. Due to inhomogeneous fiber systems, the propagation equation and soliton solutions contain variable coefficients. By selecting different forms for these variable coefficients, such as group velocity dispersion, nonlinearity, phase modulation etc, different
soliton dynamics are investigated which takes place in an inhomogeneous fiber.

This thesis is devoted to a thorough investigation of soliton propagation in various phenomena in inhomogeneous optical fibers. It presents a unified theoretical description of the effects of inhomogeneities on soliton propagation in a real fiber, their applications, existing problems, and possible solutions, particularly focusing on the soliton compression in erbium doped fiber system through dispersion decreasing fiber and soliton compression through nonlinear tunneling. The thesis begins with an investigation of nonautonomous soliton propagation in nonlinear Schrödinger with Maxwell Bloch system. It then focuses on nonautonomous soliton propagation in nonlinear Schrödinger Maxwell Bloch system with the effect of phase modulation. The thesis next deals with the investigation of coupled nonlinear Schrödinger equation with variable coefficients which describes the soliton propagation in a birefringent fiber in the picosecond regime, especially, soliton compression achieved through tunneling phenomena.

The effect of external potential on solitons in nonautonomous nonlinear Schrödinger equation with variable coefficients is investigated. It focuses on the effect of different forms of external potential on nonautonomous solitons in a real fiber system, in particular, about the impact of various external potentials such as periodic potential, exponential potential, parabolic potential, etc. Finally, soliton propagation in an inhomogeneous fiber with higher order effects is investigated, especially, the effect of third order dispersion on soliton propagation has been investigated.