Abstract of the Thesis

The present thesis deals with nonlinear evolution equations (NLEEs) in two different directions. One is to generate new nonlinear equations of interest. In this regard, the connection between quantum mechanics and NLEEs is highlighted. The conventional Korteweg-de Vries (KdV) equation is connected with a time independent constant mass (CM) Schrödinger equation which describes the motion of a quantum mechanical particle of constant mass m in the presence of the potential V. We use the concept of generalized Schrödinger equation from quantum mechanics such as position-dependent mass Schrödinger equation or time-dependent mass Schrödinger equation and using Lax pair formulation, generate new generalized KdV equation. Such generalized KdV equation possesses variable coefficient term and called as inhomogeneous KdV equation. We apply inverse scattering transform (IST) method and show that such a generalized KdV equation still possesses soliton solution. For a particular choice of mass function, we explicitly obtain mass-deformed soliton solutions. The distinct difference between conventional KdV solitons and those for generalized KdV equation is noted and illustrated by figures.

Another direction is to obtain new exact solutions of some NLEEs of physical interest through some direct methods e.g., (G'/G)-expansion method, solitary wave ansatz method etc. We propose some of their extensions such as extended $(G'/G)-$expansion method, another variation of (G'/G)-expansion method, solitary wave ansatz method in context of doubly periodic Jacobi elliptic functions etc. The NLEEs under our considerations are $(2+1)-$ dimensional Potential Kadomstev-Petviashvili (PKP) equation, Zakharov-Kuznetsov-Benjamin-Bona-Mahony equation (ZKBBM) equation, Boussinesq equation, modified Camassa-Holm (mCH) equation, generalized Kadomtsev Petviashvili modified equal width equation (gKP-MEW) equation etc. We illustrate explicit solutions of the $(2+1)$ dimensional Kadomtsev Petviashvili Benjamin-Bona-Mahony (KP-BBM) equation in presence and absence of dispersion effect in terms of Weirstrass $\wp$ functions and Jacobi elliptic functions. We develop a new technique based on the application of factorization method and the use of functional transformation to obtain new form of solutions. We also study stability analysis of the solutions by using dynamical system theory and phase plane analysis.

Keywords: Nonlinear evolution equation; KdV equation; Lax pair; Inverse scattering transform; Gel'fand-Levitan integral equation; Position-dependent mass; Effective mass; Soliton; (G'/G)-expansion method; Topological soliton; Non-topological soliton; dynamical system; Weirstrass $\wp$ function; Jacobi elliptic function.