ABSTRACT

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Title of the thesis: Studies on a Class of Non-autonomous Evolutionary Equations: Integrability, Exact Solutions, Qualitative Analysis, and Applications in Plasma Dynamics.

In chapter (1), the goals and importance of the current study are discussed. Definitions, a few essential properties, and the basic equations required for the research project are also provided.

Chapter (2) illustrates the infinite conservation law, quasi-periodic wave, breather, lump, and characteristic of integrability of the non-autonomous Kadomtsev-Petviashvili (NKP) equation through bilinear Bäcklund and lax pair. We derive the quasi-periodic solution and examine the periodic wave's asymptotic behaviour. Furthermore, lump, breather, and different complex structures solution for the NKP equation are investigated.

Chapter (3) uses Painlevé analysis, bilinear Bäcklund, and lax pairs to illustrate the integrability of the nonautonomous KP-modified KP equation. Several sorts of solutions including multi-solitons, smooth positons, and breathers are investigated through Hirota's bilinear technique. Using bifurcation theory, a qualitative study of the nonautonomous KP-modified KP equation is performed.

The Kadomtsev-Petviashvili-modified Kadomtsev-Petviashvili (KP-mKP) equation is shown to have some forms of efficient solutions in Chapter (4). The introduction of Liu's method for the full polynomial discrimination system addresses periodic wave profiles as well as shock waves and solitary waves.

The damped Gardner-Burgers (dGB) equation is discussed in Chapter (5), where several solutions are investigated using the (G'/G)-expansion approach and the approach of Undetermined Coefficient. These solutions produce various wave shapes and contain discrete sets of arbitrary functions, such as exponential and hyperbolic functions.

In Chapter (6), the propagating properties of dust acoustic waves (DAWs) in collisionless, unmagnetized, viscous dusty plasma are analysed through the KP equation and the Kadomtsev-Petviashvili Burgers (KPb) equation. Using various techniques, shock, solitary, and periodic solutions are obtained from the appropriate frameworks. Lastly, numerical examples are provided to show how the physical characteristics affect the wave propagation in the current system.

Chapter (7) examines the properties of ion-acoustic waves propagating through a relativistic electron-positron-ion (EPI) plasma when a relativistic positron beam is present. The Korteweg-de Vries (KdV) equation and modified Korteweg-de Vries (mKdV) equation are derived using the fundamental set of fluid equations. Different sorts of solutions, including periodic and breather ones, are derived in both models. The wave propagation model incorporates numerical information of several physical parameters in the physical environment.

A summary of our complete investigation, along with a discussion of possible avenues for future research, is provided in Chapter (8)

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