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Master Thesis Defense**

Entitled

*USING THE HIROTA METHOD TO INVESTIGATE THE INTEGRABILITY AND NEW EXACT  
SOLUTIONS OF THE NON-AUTONOMOUS NONLINEAR SCHRÖDINGER EQUATION*

by

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Abstract

In this thesis research, we investigate the existence of Hirota bilinear systems for the non-autonomous nonlinear Schrödinger equation (NLSE) with position- and time-dependent coefficients and external potentials. To that end, we employ a semi-analytical systematic method that employs some exact solutions. The Hirota bilinear system is then employed to derive new solutions to the same nonlinear differential equation. We have applied this approach to a number of different versions of NLSEs to find that each family of solutions shares the same Hirota bilinear system. Furthermore, properties of solutions such as stability are investigated.

**Keywords:** NLSE, Hirota Bilinear System, Integrability, Stability, Solitons, Logarithmic Transformation, Rational Transformation.