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A New Integral Transform for Solving Higher Order Ordinary Differential Equations

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Abstract: In this work a new integral transform is introduced and applied to solve higher order linear ordinary differential equations with constants coefficients and variable coefficients as well as. We compare the present transform with other existing transforms such as the Laplace, Elzaki, Sumudu and other ones.

Keywords: *integral transform; ordinary differential equations; Laplace transform; Sumudu transform; Elzaki transform.*

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1 Introduction

The differential equations have played a fundamental role in every aspect of applied mathematics for a very long time [1, 5–8, 10, 15, 19, 20]. Integral transform methods have been modified to solve several dynamic equations with initial or boundary conditions in many ways the Laplace, Sumudu and Elzaki transforms are such typical tools [4, 5, 9, 11–15]. In this paper we introduce a new integral transform and then some relationship between this transform and the Laplace, Sumudu, Elzaki and natural transforms; further, for the comparison purpose, we apply all transforms to solve differential equations to see the differences and similarities. Finally, we provide some examples relating to the second order differential equations with non-constant coefficients as a special case. For the function $f(t)$ that is piecewise continuously differentiable in every finite interval and is absolutely integrable on the whole real line the following integral equations hold true in the domain $-\infty < t < +\infty$:

$$\mathcal{F}\{f(t)\} = F(k) = \frac{1}{\sqrt{2}} \int_{-\infty}^{+\infty} e^{-ikt} f(t)\, dt, \quad t \neq 0. \tag{1}$$

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