

# **Dedication**

To our families

## **Acknowledgments**

Thanks first and last to Allah who enabled to conduct this by grace of Him and denoted strength and patience.

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## **Abstract**

This dissertation, dealt with solving differential equations with variable coefficients and differential equations of the higher order using the Sumudu transform.

In chapter one, the Sumudu transform, and the relation between it and Laplace transform where explained. As well as some important characteristics, theories, where stated and gave through examples.

In chapter two the researcher applied the Sumudu transform on some types of special functions, as well as solving differential equations with variable coefficients.

In chapter three apply the Sumudu transform solving some examples of ordinary differential equations as well as solving differential equations with higher order in the solution of some special types of equations.

Finally, the result is that Sumudu transform of competes the Laplace transform in finding solution of differential equation obviously.

## الخلاصة

تناول الباحث في هذا البحث حل المعادلات التفاضلية ذات المعاملات المتغيرة و المعادلات التفاضلية من الرتب العليا باستخدام تحويل سومودو .

في الباب الأول وضحنا تحويل سومودو والعلاقة بينه وبين تحويل لابلاس. وكذلك بعض الخصائص والنظريات الهامة وأعطينا أمثلة على ذلك.

في الباب الثاني طبق تحويل سومودو على بعض أنواع الدوال الخاصة و في حل المعادلات التفاضلية ذات المعاملات المتغيرة.

أما في الباب الثالث تم تطبيق تحويل سومودو لحل بعض الأمثلة للمعادلات التفاضلية العادية و المعادلات التفاضلية ذات الرتب العليا وكذلك بعض أنواع المعادلات الخاصة.

وقد تم استنتاج إن تحويل سومودو ينافس تحويل لابلاس في إيجاد حلول المعادلات التفاضلية بشكل واضح.

## Introduction

In the literature there are numerous integral transform and widely used in physics, astronomy as well as in engineering. The integral transform method is also an efficient method to solve the differential equations. The integral transform was applied to partial differential equation with non-homogenous forcing term and having singular variable data. Recently, Watugala introduced a new transform and named as Sumudu transform which is defined by the following formula

$$F(u) = S[f(t); u] = \int_0^{\infty} \frac{1}{u} \exp\left(-\frac{t}{u}\right) f(t) dt$$

And applied this new transform to the solution of ordinary differential equation and control engineering problems, some fundamental properties of the Sumudu transform were established.

In this study, our purpose is to show the applicability of this interesting new transform and its efficiency in solving the linear ordinary differential equations with constant and non constant coefficients and higher order differential equations.