SOLUTION OF SECOND ORDER ORDINARY DIFFERENTIAL EQUATION USING ADOMIAN DECOMPOSITION

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CERTIFICATION

This is to certify that this project was carried out by **ELUTADE, Isaiah Abiola** with Matriculation Number 17/56EB050 in the Department of Mathematics, Faculty of Physical Sciences, University of Ilorin, Ilorin, Nigeria, for the award of Bachelor of Science (B.Sc.) degree in Mathematics.

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ACKNOWLEDGMENTS

All praises

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DEDICATION

I would like to dedicate the project to God, for the grace and faithfulness of God thus far. For His mercies, guidance and protection throughout my years of study.

ABSTRACT

In this project,

Table of Contents

Chapter 1

INTRODUCTION TO ADOMIAN DECOMPOSITION METHOD (ADM)

1.1 General Introduction

The Adomian Decomposition Method (ADM) was first established in the 1980's by George Adomian, chairman of Center for Applied Mathematics at the University of Georgia. In the recent years, this method of Adomian Decomposition has be paid attention to in the field of applied mathematics and series solution. In addition, the ADM is widely used to obtain the solution to many types of linear or non-linear ordinary differential equation and integral equations.

The ADM gives the accurate and efficient solution to problem in a direct and simply way without the use of linearization and partubation which can change the physical behaviour of the method.

For the purpose of this study, we consider the solution of second order differential equation of the form

$$P(x)\frac{d^2y}{dx^2} + Q(x)\frac{dy}{dx} + R(x)y = F(x)$$

or

$$y''P(x) + y'Q(x) + R(x)y = F(x)$$

with initial conditions

$$y(x_0) = y_0 \text{ and } y'(x_0) = y_1$$

Where $P(x), Q(x), R(x)$ and $F(x)$ are continuous functions of x; and y_0 and y_1 are given constant.

1.2 Definition of Relative Terms

1.2.1 Differential Equation

Differential equation is an equation that contains at least one derivative of an unknown function, either ordinary derivative $\left(\frac{d}{dy}\right)$, or a partial derivative $\left(\frac{\partial}{\partial x}\right)$.

1.2.2 General Second Order Ordinary Differential Equation

The general Second Order Ordinary Differential Equation of an independent variable x and dependent variable y is given by

$$P(x)\frac{d^2y}{dx^2} + Q(x)\frac{dy}{dx} + R(x)y = f(x) \qquad \text{Or}$$

$$y''P(x) + y'Q(x) + R(x)y = f(x)$$

where $P(x), Q(x), R(x), f(x)$ are continuous functions of x.

1.2.3 Initial Value Problem

An initial-value problem for the second order equation

$$y''P(x) + y'Q(x) + R(x)y = f(x)$$

consists of finding a solution y of the differential equation that also satisfies initial condition of the form

$$y(x_0) = y_0 \qquad\qquad y'(x_0) = y_1$$

where y_0 and y_1 are given constants and $P(x), Q(x), R(x), f(x)$ are continuous functions of x and $P(x) \neq 0$.

1.2.4 Operator

An operator is a function that takes a function as an argument instead of number. Examples of operators are:

$$L = \frac{d}{dx}\ ;\ L = \frac{\partial}{\partial x}\ ;\ \ L = \int dx\ ;\ L = \int_a^b dx$$

1.2.5 Adomian Polynomials $(\mathbf{A_n})$

The Adomian Polynomials of a non-linear differential equation is obtained using the formula

$$A_n = \frac{1}{n!}\ \frac{d^n}{d\lambda^2}\left[N\left(\sum_{n=0}^{\infty}\lambda^n U_n\right)\right]_{\lambda=0} \qquad n = 0, 1, 2, \ldots \qquad (1.1)$$

1.3 Aims and Objectives

1.3.1 Aim

The aim of this project work is to adopt the method of Adomian decomposition to solve Linear and Non-linear Second Order Differential Equation of the form

$$y''P(x) + y'Q(x) + R(x)y = f(x)$$

where $P(x), Q(x), R(x), f(x)$ are continuous functions of x.

1.3.2 Objectives

The objectives of this study are to

1. Describe Adomian decomposition method
2. Use ADM to solve linear ordinary differential equation
3. determine the solution of second order ordinary differential equation by Adomian decomposition method

1.4 Significance of the Project

The importance or significance of this project is to apply Adomian Decomposition Method to solve linear and non-linear ordinary differential equation of second order will converges the problem to its exact solution.

1.5 Outline of the Project

The project is divided into five chapters. Chapter one consists of the introduction, definition of relevant terms, aims and objectives, significance of the project and project outline.

Chapter two consist of literature review, Chapter three consists of methodology; method of solution of ADM; Numerical examples on Adomian Polynomial; Numerical examples of linear ordinary differential equation.

Chapter four consist of methodology, Numerical examples on Non-linear ordinary differential equation. Chapter five consist of discussion of result; conclusion and recommendation for further study.

Chapter 2

2.1

Chapter 3

METHODOLOGY

3.1

Chapter 4

Chapter 5

SUMMARY AND CONCLUSION

5.1 Summary

5.2 Conclusion

REFERENCES