**WAVE EQUATION AND ITS APPLICATIONS**

**A SEMINAR 2 PRESENTATION**

**BY**

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# CERTIFICATION

This is to certify that this report was undertaken and submitted by **OLALERE BABATUNDE**with matriculation number **20183060**, a student of the department ofMathematics, College of Physical Sciences, Federal University of Agriculture, Abeokuta, for SEMINAR 2.

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# INTRODUCTION

## 1.1 Introduction

In the vast and intricate tapestry of the physical world, the phenomenon of waves is ubiquitous and captivating. From the gentle rustling of leaves in the wind to the roaring crescendo of ocean waves crashing on the shore, from the harmonious melodies of music to the transmission of information through wireless communication, waves are fundamental to our understanding of nature and the technologies that shape our lives.

At the heart of comprehending and harnessing these wondrous phenomena lies a mathematical gem known as the wave equation. This seemingly simple yet profoundly versatile equation has been a cornerstone of physics and mathematics for centuries, enabling us to decipher the intricate dance of waves as they traverse through space and time. Its applications, spanning a multitude of disciplines, are as diverse as they are powerful, making it a linchpin in the scientific and engineering landscapes.

In this exploration, we embark on a journey through the waves—both literal and figurative—that the wave equation unveils. We will delve into the mathematical intricacies of this equation, uncover its elegant solutions, and witness its transformative impact on fields as varied as physics, engineering, medicine, and more. The wave equation, at its essence, is a key to understanding the world around us and a tool to shape the world we imagine.

In this project, we will unravel the mysteries of the wave equation, explore its applications across diverse domains, and glimpse into the future where its influence continues to expand. Join us as we ride the crest of knowledge and dive deep into the depths of wave phenomena, for the journey promises to be both enlightening and inspiring.

## 1.2 Preliminaries and Definitions of Terms

Before delving into the intricacies of the wave equation and its applications, it's essential to establish a foundational understanding of key terms and concepts that will be central to our exploration.

* **Wave**: A wave is a disturbance or oscillation that propagates through a medium or space, transferring energy without the physical displacement of matter. Waves can take various forms, including mechanical waves (e.g., sound waves), electromagnetic waves (e.g., light and radio waves), and more.
* **Medium**: The medium refers to the substance or material through which a wave travels. It can be a solid (e.g., a rope for mechanical waves), a liquid (e.g., water for ocean waves), or even a vacuum (for electromagnetic waves).
* **Wave Equation**: At its core, the wave equation is a mathematical representation that describes how waves behave and propagate through a given medium or space. It is a partial differential equation that relates the second derivative of a wave function with respect to both time and space coordinates.
* **Time Domain and Spatial Domain**: When dealing with waves, it's common to analyze them in both the time domain (how the wave evolves over time) and the spatial domain (how the wave varies in space). These domains are essential for understanding the complete behavior of waves.
* **Wave Speed**: The wave speed (often denoted as "c") is a fundamental property of a wave and represents how fast the wave propagates through the medium. It depends on the properties of the medium, such as its density and elasticity.
* **Wavelength**: The wavelength (denoted as "λ") is the spatial period of a wave, representing the distance between two successive points in a wave that are in phase (e.g., two consecutive crests or troughs).
* **Frequency**: The frequency (denoted as "f") of a wave is the number of oscillations or cycles that occur per unit of time. It is inversely proportional to the wavelength and determines the pitch (for sound waves) or color (for light waves) of the wave.
* **Amplitude**: The amplitude of a wave (denoted as "A") represents the maximum displacement of a point on the wave from its equilibrium position. It is a measure of the wave's intensity or strength.
* **Phase**: The phase of a wave describes the relative position of a point on the wave with respect to a reference point. It is often expressed in radians or degrees.
* **Boundary Conditions**: In the context of the wave equation, boundary conditions are constraints that specify how the wave behaves at the boundaries of the medium or the region of interest. They play a crucial role in determining the solutions to the wave equation.

## 1.3 Literature Review

## 1.4 Problem Section

### 1.4.1 Statement of Problem

### 1.4.2 Motivation

### 1.4.3 Existing Approaches

## 1.5 Objectives

# 2.0 DISCUSSION

# 3.0 CONCLUSION AND RECOMMENDATION

## 3.1 Conclusion

## 3.2 Recommendation