UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

D'ALEMBERT FORMULA FOR WAVE EQUATION

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IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST BENEFICIENT, THE MOST MERCIFUL.

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ABSTRACT

The title of this project is d'Alembert Formula For Wave Equation. The purpose of this project is to solve the wave equation problem by using d'Alembert formula and show that the wave is traveling towards opposite directions. First, d'Alembert formula is derived from the wave equation. Then, a few wave problems have been chosen and solved. Various graphs have been plotted by using Maple Software, which show that it is proven the wave is traveling towards two opposite directions. After all of the three steps of methodology have been done, the results achieved is as wanted. The results have shown that the d'Alembert formula can be used to solve wave equation problems. This formula also can be used to prove that the wave is travelling in two opposite directions.

1 INTRODUCTION

1.1 Introduction

In physics, the description of waves such as light waves, water waves and sound waves which is an important second-order linear partial differential equation can be described by the wave equation.

Historically, Jean le Rond d'Alembert, Daniel Bernoulli ,Joseph-Louis Lagrange and Leonhard Euler have been investigated about the problem of a vibrating spring (Cannon et al., 1983). D'Alembert had found the one-dimensional wave equation in 1746 and after ten years, Euler found the three-dimensional wave equation (Spesier, 2008).

This project involves one-dimensional wave equation which the standing wave is produced from two waves with the same amplitude, wavelength, and frequency travel in opposite directions.

The wave equation for u is

$$u_{tt} = a^2 u_{xx} \tag{1}$$

where a^2 is a fixed constant.

The solutions of the equations describe the propagation of disturbances out of the region at fixed speed. The constant a^2 is denoted as the propagation speed of wave. It is a linear equation. The superposition principle which is the solutions is again a solution or the sum of any two functions is thus applied in this project.