

UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

SOLVING LINEAR AND NONLINEAR
ORDINARY DIFFERENTIAL EQUATIONS
USING VARIATIONAL ITERATION METHOD

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ABSTRACT

The primary purpose of this study is to apply the variational iteration method (VIM) to solve linear and nonlinear second order ordinary differential equations (ODE). VIM is the chosen method because it does not require linearization of equation. One linear and one nonlinear equation called the Duffing equation are solved by using VIM. In this paper, the approximate solutions for several iterations for both equations are determined. All the workings in this study are computed by using Maple. Graphs and tables are provided to give comparison between the given exact solution and the approximate solution found through VIM. The results show that VIM is an efficient and powerful tool to give accurate solutions to linear and nonlinear second order ordinary differential equations as it gives several successive approximations.

1 INTRODUCTION

1.1 Research Background

There is always mathematics behind the occurrences in our daily lives. It could be an easy calculation such as figuring out how much we need to pay for our lunch, or a slightly complicated calculation such as determining our Body Mass Index (BMI). Meanwhile, for a more complex system such as modeling the series circuits or the mechanical systems with several springs attached, innumerable problems in engineering and science field have been mathematically modeled by differential equation systems (Salehpoor et al., 2010).

According to Zill & Wright (2013), an equation consisting of the derivatives of at least one dependent variable, with respect to at least one independent variable is called differential equation. It can be categorized according to the type, order and linearity. The types of differential equation can be divided into two; ordinary differential equation (ODE) and partial differential equation (PDE). An equation that contains at least one unknown function with respect to a single independent variable is called ODE, while it is PDE if the functions are with respect to at least two independent variables. The Duffing equation, which was proposed by Georg Duffing, is a nonlinear second-order differential equation that is applied in describing some damped and driven oscillators. The equation describes chaotic behaviour in a system in the simplest equations (Kovacic & Brennan, 2011).

The rapid development and growth of science and mathematics field has induced the development of many methods if not still being developed, in order to solve problems that involve ODE and PDE. Essentially, the newly developed methods produce better approximations to the solution of mathematical problems. For example, Adomian Decomposition Method (ADM) is used to find the solution to multipoint boundary value problems (Tatari & Dehghan, 2006). Mohyud-Din & Noor (2009) used homotopy perturbation method (HPM) to work out the problem involving partial differential equations. Another famous method was developed in 1999 by