UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

APPROXIMATE SOLUTION OF LINEAR HOMOGENEOUS SINGULAR PERTURBATION PROBLEM OF SECOND ORDER ORDINARY DIFFERENTIAL EQUATION USING DIFFERENTIAL TRANSFORM METHOD (DTM)

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

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ABSTRACT

In this research, a reliable algorithm is presented to develop an approximate solution of second order singular perturbation in which the highest order derivative is multiply with the small parameter, epsilon. In this method, the given problem and its boundary are transformed based on the table of the fundamental theorem of DTM.

Then, from the transformed equation, the recurrence relation will be obtained and the equation with this problem can be solved using DTM. The accuracy and efficiency of the method are proved by some illustration of examples and by comparing the results with the exact solution. The obtained result is showing that DTM method is easy and convenient and efficient to use.

1   INTRODUCTION

Differential equation is an equation containing the derivatives of one or more unknown functions (or depending variables), with respect to one or more independent variables. It can be classified according to their type, order and linearity. The type can be classified into two that is Ordinary Differential Equation(ODE) and Partial Differential Equation(PDE). The order of a differential equation for both ODE and PDE can be showed from the order of the highest derivative of the equation and the linearity can be classified into two where is linear and nonlinear. (Idrees et al., 2013)

Arising from the applied science and mathematics has make the perturbation problem become popular nowdays. According to Abdel-Halim Hassan (2008), perturbation problem can be divided into two that is singular perturbation and regular perturbation. Singular perturbation problem is when a parameter with the small value multiples with the highest derivative.There will have a difficulty in order to solve the equation when the epsilon,ε leads to zero and it is showing the convergence that cannot be uniform if numerical classical techniques are used. It will change rapidly and varies slowly in a certain piece of the resolution.

There are many methods to solve perturbation DE such as DTM, Multiple Scale, Match Asymptotic Expansion and so on. DTM is a popular and give accurate solution. The basic idea of the DTM was introduced by Zhou (Rawashdeh & Maitama, 2015). A variety of numerical and analytical methods have been developed to get the accurate approximate and analytic solutions for the problems in the equation. The classical Taylor series method is one of the earliest analytic technique to various problems, especially in ODE. However, it has needed many of symbolic calculation for the derivatives of functions, it takes a lot of computational time for higher order derivatives. Then the updated Taylor series method was introduced known as Differential Transform Method(DTM). The DTM is the method to determine the coefficients