UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

NUMERICAL SOLUTION FOR UNSTEADY MICROPOLAR FLUID OVER A PERMEABLE CURVED STRETCHING AND SHRINKING SURFACE BY USING BVP4C

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ABSTRACT

This study aimed to analyse the numerical solution for the unsteady flow of a micropolar fluid over a permeable curved surface that stretches and shrinks. The term unsteady denotes that the fluid flow undergoes time-dependent changes, while micropolar fluid refers to a type of fluid that considers microstructural rotations. A permeable curved stretching and shrinking surface refers to a solid boundary over which a fluid flows that allowing the fluid to pass through and having a curved shape with varying curvature, where some regions of the surface expand and others contract during the fluid flow process. The problem of this study is to investigate the behaviour of an unsteady micropolar fluid over a permeable curved stretching and shrinking surface by using BVP4C method. MATLAB was the software that was used to solve the problem. To use MATLAB software, the partial differential equation (PDE) needs to transform into an ordinary differential equation (ODE) using the similarity transformation approach. The resulting mathematical model is solved using MATLAB software with various parameter values. The objective of the study was to convert the governing boundary layer equations into nonlinear ordinary differential equations via similarity transform and BVP4C is used to analyse the numerical solution. The impacts of different parameters on the skin friction and couple stress on the fluid flow were investigated, and these effects were visually depicted through graphical illustrations. The results revealed the existence of dual solutions for different types of surfaces and concentration regimes. As a recommendation for future research, the report proposes investigating the dynamics of an unsteady micropolar fluid over a permeable curved stretching and shrinking surface using alternative methods such as BVP5C. This study discovered multiple solutions for different surface types and concentrations, which enhances the comprehension of the intricate dynamics of unsteady micropolar fluid flow over curved surfaces. Overall, our study provided insights into the complex behaviour of unsteady micropolar fluid flow over curved surfaces and could have practical applications in the design of microfluidic devices and other engineering contexts.