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THE FLOW AND THERMAL PROPERTIES OF RADIATING MAGNETOHYDRODYNAMICS HYBRID NANOFLUID OVER AN INCLINED PLANE

(*Sifat-sifat Aliran dan Terma Magnetohidrodinamik Nanobendalir Hibrid Memancar di atas Satah Condong*)

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ABSTRACT

In recent times, incorporating nanoparticles when studying the boundary layer flow has caught attention of many researchers due their promising abilities to elevate the thermal exchange within a fluid structure. In virtue of the vast applications in engineering and industrial fields, extending/compressing sheet, magnetic field and thermal radiation have been the persistently added controlling effects to the flow environment through years. Subsequently, this study investigates the flow and thermal properties of Ethylene Glycol (EG) magnetohydrodynamics hybrid nanofluid accommodating $CoFe_2O_4$ and TiO_2 nanoparticles passing a slanted extending/compressing plane with thermal radiation. Employing similarity transformation, the problem's governing equations are altered to an array of ordinary differential equations. The solver function for boundary value problem (bvp4c) provided by MATLAB software is applied to numerically solve these ordinary differential equations. The occurrence of numerical solutions for specific values of volume fraction of nanoparticles has been observed upon utilization of MATLAB. For diverse values of the parameter, the findings for flow and thermal profiles are portrayed graphically. Additionally, the influence of extending/compressing sheet rate and volume fraction of nanoparticles on the skin friction coefficient and local Nusselt number are also investigated. It has been perceived that the profiles of flow and thermal are enhanced when volume fraction of $CoFe_2O_4$ and TiO_2 are increased for the extending plane case. The opposite effects in flow and thermal profiles are noticed for compressing plane case.

Keywords: hybrid nanofluid; thermal radiation; extending/compressing inclined plane

ABSTRAK

Sejak kebelakangan ini, penggabungan nanozarah dalam kajian aliran lapisan sempadan menjadi perhatian ramai penyelidik kerana kebolehan zarah-zarah tersebut untuk meningkatkan prestasi pertukaran haba dalam sesebuah sistem bendalir. Disebabkan aplikasi dalam bidang kejuruteraan dan industri yang luas, satah memanjang/memampat, medan magnet dan pancaran haba menjadi elemen mengawal yang ditambah kepada persekitaran aliran secara berterusan selama ini. Seterusnya, kajian ini menyiasat sifat-sifat aliran dan terma magnetohidrodinamik nanobendalir hibrid etilena glikol (EG) dengan nanozarah-nanozarah $CoFe_2O_4$ dan TiO_2 di atas satah condong memanjang/memampat dengan pancaran haba. Menggunakan kaedah transformasi persamaan, persamaan yang mengawal ditransformasikan kepada set persamaan pembezaan biasa. Fungsi penyelesai bagi masalah nilai sempadan (bvp4c) dalam perisian MATLAB telah digunakan untuk menyelesaikan persamaan-persamaan pembezaan biasa tersebut secara berangka. Kewujudan penyelesaian berangka untuk nilai khusus pecahan isipadu nanozarah diperhatikan setelah menggunakan perisian MATLAB. Untuk pelbagai nilai parameter tersebut, penemuan bagi profil halaju dan terma dipersembahkan dalam bentuk graf. Tambahan pula, impak pecahan isipadu nanozarah dan kadar memanjang/memampat terhadap pekali geseran permukaan dan nombor Nusselt tempatan juga disiasat. Ia didapati bahawa profil halaju dan terma dipertingkatkan apabila pecahan isipadu $CoFe_2O_4$ dan TiO_2 ditingkatkan bagi kes satah memanjang. Kesan yang bertentangan terhadapa profil halaju dan terma dapat diperhatikan bagi kes satah memampat.

Kata kunci: nanobendalir hibrid; pancaran haba; satah condong memanjang/memampat

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