UNIVERSITI TEKNOLOGI MARA

MIXED CONVECTION ON BOUNDARY LAYER FLOW IN A DARCY-BRINKMAN POROUS MEDIUM WITH SLIP EFFECTS AND POROUS DISSIPATION

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BSc

July 2025

ABSTRACT

Mixed convection plays a pivotal role in fluid flow and heat transfer phenomena, especially within porous media commonly encountered in industrial and environmental systems. This study investigates the combined effects of mixed convection, slip boundary conditions and porous dissipation on boundary layer flow over a permeable stretching surface embedded in a Darcy-Brinkman porous medium. These mechanisms are particularly relevant for enhancing thermal performance in applications such as geothermal systems, filtration technologies and thermal insulation processes. The governing partial differential equations for continuity, momentum and energy were transformed into ordinary differential equations using similarity transformations and numerically solved via the Runge-Kutta-Fehlberg method in Maple software. The study evaluates the effects of several dimensionless parameters which are mixed convection parameter, Brinkman parameter, porosity parameter, suction parameter, velocity slip parameter, thermal slip parameter, Prandtl number and Eckert number on skin friction coefficient, local Nusselt number, velocity profile and temperature profile. The findings show that an increased variation of mixed convection parameter promotes the effect of buoyancy, decreasing the skin friction and improving the heat transfer. Enhancement of Brinkman parameter and Eckert number lowers the magnitude of skin friction and heat transfer due to amplified viscous and thermal diffusion. Higher porosity parameter and thermal slip parameter results in stronger skin friction and decreased thermal temperature gradients. Both skin friction and heat transfer increase as the suction parameter and Prandtl number increase. Raising velocity slip parameter leads to a rise in heat transfer, with a subsequent decrease in velocity gradient. These results provide an opportunity for optimising thermal-fluid systems where porous structures are involved.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my deepest gratitude to Allah SWT for granting me the strength, patience and perseverance to complete this research successfully.

I would also extend my gratitude to my beloved family for their support, prayers and encouragement throughout my academic journey. Their love and sacrifices have been a great source of motivation and inspiration for me.

I would also like to sincerely thank my supervisor, Zanariah binti Mohd Yusof for your invaluable guidance, constructive feedback and continuous support throughout the course of this study. Your expertise and dedication have played a significant role in the development of this research.

I am equally grateful to my mate, Noor Atirah binti Ismail, for your collaboration, support and companionship. Working alongside you has been a rewarding experience and your contributions have greatly enriched this research.

To all those who have supported me in any respect during the completion of this study, thank you.

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