UNSTEADY SHEAR-STRESS-DRIVEN FLOW OF NEWTONIAN AND NON-NEWTONIAN POWER-LAW FLUIDS AROUND A DRY PATCH WITH STRONG SURFACE-TENSION EFFECT

NURUL FARIHIN BINTI AZMEL

Thesis submitted in fulfilment
of the requirement for the degree of
Bachelor of Science (Hons.)
Mathematical Modelling and Analytics

College of Computing, Informatics and Mathematics
Universiti Teknologi Mara

July 2024

ABSTRACT

Since early discovery by past researchers, thin films quickly found industrial uses in areas like decoration and optics. As thin film technology advanced, aided by the progress in vacuum technology and electric power infrastructure, their applications expanded. Today, nearly every industrial sector utilises thin films to impart specific physical and chemical properties to the surfaces of bulk materials. This research studies the thin-film flows of Newtonian and non-Newtonian power-law fluids on an inclined plane. Certainly, flow around dry patch driven by shear stress in strong surface tension effects. The continuity equation and Navier-Stokes equations are used for this research. These equations are subject to the boundary conditions of no-slip and no penetration, the balances of normal and tangential stress with the kinematic condition to get a fourth-order governing partial differential equation. Then, the governing partial differential equation is reduced to get the ordinary differential equation by using the similarity transformation method. Finally, the governing fourth-order ordinary differential equation is solved using Runge-Kutta Fehlberg Fourth Fifth (RKF45) method and Maple is used to show the results. There are two similarity solutions that are obtained for dry patches which are monotonically increased cross-sectional profile and sharp transition to zero thickness at specific positions.

ACKNOWLEDGEMENT

In the name of Allah, the Most Merciful and Gracious. Praise be to Allah, the world's preserver and provider. Firstly, I would like to formally express my appreciation and express my heartfelt thanks to my supervisor, Dr. Nurul Ainina Redwan, for her excellent assistance and encouragement during this thesis. In addition, I would like to express my gratitude to the Universiti Teknologi Mara lecturers for their assistance in providing me with the means to continue my studies. Not to mention all my friends who have supported me greatly. Finally, but just as importantly, I remember with gratitude the unwavering love and encouragement I received from my family.

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