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DECLARATION

I declare that the dissertation hereby submitted to the University of Limpopo for the degree of Master of Science has not previously been submitted by me for the degree at this University or any other University, that is my own work in design and in execution, and that all material contained therein has been duly acknowledged.

Signed : ___________________________________

Date : ___________________________________

CERTIFICATION

I certify that this work was carried out by Mfumadi Komane Boldwin under my supervision in the Applied Mathematics, University of Limpopo, Private bag X 1106 Sovenga 0727, South Africa.

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Supervisor

Professor O.D Makinde

DEDICATION

To my family, my mother (Engelinar Mashahlama Mfumadi), my sisters (Makosa Beauty Nakeng, Rudzane Preyer Mfumadi, Maidi Victoria Mfumadi, Tshegofatso Mfumadi) also to my brothers (Phillinom Tebogo Mfumadi, Chembry Mashoto Mfumadi, Mohau Given Mfumadi), my relatives (Mabatho Matloma, Gladys Rebane) to my koko (Macharaka Willson Mfumadi, Molatelo Puledi Mfumadi, Mapula Madibele), to my pastor (Maile Seshoene, Jeremiah Sekgobela), to my associate (Mack Zachariah Matlabjane, Peter Mhone), to my fellow Christians and all my friends. Thank you for all the support you have given me. Above all thank to the **ALMIGHTY GOD** through His Son **JESUS CHRIST.**

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Abstract

Understanding the effects of blood viscosity variation plays a very crucial role in hemodynamics, thrombosis and inflammation and could provide useful information for diagnostics and therapy of (cardio) vascular diseases. Blood viscosity, which arises from frictional interactions between all major blood constituents, i.e. plasma, plasma proteins and red blood cells, constitutes blood inherent resistance to flow in the blood vessel. Generally, blood viscosity in large arteries is lower near the vessel wall due to the presence of plasma layer in this peripheral region than the viscosity in the central core region which depends on the hematocrit.

In this dissertation, the flow of blood in a large artery is investigated theoretically using the fluid dynamics equations of continuity and momentum. Treating artery as a rigid channel with uniform width and blood as a variable viscosity incompressible Newtonian fluid, the basic flow structure and its stability to small disturbances are examined. A fourth-order eigenvalue problem which reduces to the well known Orr–Sommerfeld equation in some limiting cases is obtained and solved numerically by a spectral collocation technique with expansions in Chebyshev polynomials implemented in MATLAB. Graphical results for the basic flow axial velocity, disturbance growth rate and marginal stability curve are presented and discussed. It is worth pointing out that, a decrease in plasma viscosity near the arterial wall has a stabilizing effect on the flow.

In Chapter one, a review of the background study on the arterial blood flow together with relevant literatures are presented. A mathematical model of the variable viscosity arterial blood flow is proposed, analysed and discussed in Chapter two. In Chapter three, a detail linear stability analysis of the problem is presented and in Chapter four the resulting eigenvalue problem obtained from the linear stability analysis is solved numerically using Chebyshev collocation spectral method.