Acknowledgements

ACKNOWLEDGEMENTS

I wish to record my heartfelt thanks to honorable founders late **Sri. G. R. Govindarajulu**, Founder Trustee and **Smt. Chandrakanthi Govindarajulu**, Founder Correspondent of PSGR Krishnammal College for Women, who endeavored to offer high quality education for women with strong intellect and constantly empowered women over decades.

I am highly indepted to **Smt. Dr. R. Nandini**, Chairperson, PSGR Krishnammal college for women and **Sri. G. Rangaswamy**, Managing Trustee, GRG Trust for giving me the wonderful opportunity to do my docotoral programme in their esteemed Institution.

I would like to express my whole hearted thanks to **Dr. N. Yesodha Devi**, M.Com, Ph.D., Secretary, PSGRKC and my deepest sense of gratitude goes to **Dr. S. Nirmala**, MBA, M.Phil, Ph.D, Principal, PSGRKC for extending all the necessary facilities to carry out the research work at the Institution.

I have great pleasure in expressing my deepest sense of gratitude and indepeteness to my supervisor **Dr. K. Sumathi**, M.Sc, M.Phil, Ph.D.,PGDCA, Associate Professor, Department of Mathematics, PSGR Krishnammal College for Women, Coimbatore for her constant encouragement, untiring, sympathetic and generous help rendered all the time without which this thesis could not have been accomplished. This was possible only because of the unconditional support provided by Madam.

I wish to record my heartfelt thanks to our former Heads of the Department of Mathematics, **Mrs. V. Vijayalakshmi**, M. Sc, M. Phil., **Dr. S. Chitra**, M. Sc, M. Phil, Ph.D., **Dr. B. Tamilselvi**, M. Sc, M. Phil, Ph.D., **Dr. L. Lakshmanan**, M.Sc., M. Phil., Ph.D., Dean, Mathematical Sciences and **Ms. A. Karpagam**, M. Sc., Head of the Department for the constant encouragement and inspiration all the time.

My sincere thanks are due to my colleagues in and outside the department who have been a source of inspiration throughout this work.

I take this time to express my gratitude to one and all, who directly or indirectly have extended their support and encouragement rendered throughout the completion of my research work.

Special thanks are due to my parents **Mr. K. P. Rangasami – Mrs. R. Sarasumani**, in-laws **Mr. K. Kumarasamy – Mrs, K. Sarojini**, my Husband **Mr. K. Saravanan**, my children **Miss S. Praneetha and Master S. P. Krishnav** and friends for their valuable motivation and support throughout my period of research. Above all I thank God the almighty who made all things possible.

- R. Panneerselvi

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Preface

PREFACE

Shear flow instabilities are remarkably important in a number of astrophysical, geophysical, atmospheric and laboratory contexts. One of the scholastic problems of hydrodynamic theory is the stability analysis. Analytic approach is adopted for couette flows. Interesting research takes place on instability of magneto hydrodynamic shear flow.

This thesis deals with the linear stability analysis of magneto hydrodynamic stratified shear flows with careful attention to acquire the general analytical results for the stability of flow between two infinite rigid planes.

Chapter I focuses on the introductory concepts of the stability analysis and stratified shear flows. Preliminaries related to shear flow stability, methods of analysis, applications and a brief discussion of the original work done are presented in this chapter.

A literature review is a descriptive, analytical summary of the existing sources related to a particular area of study. It involves a systematic examination of prior scholarly works. Hence, In Chapter II, literature review is presented which are relevant to the problems considered in this thesis.

In Chapter III, the work of Padmini and Subbiah (1995) is extended to explore the effect of applied magnetic field on stratified non-parallel and parallel shear flows. Using normal mode analysis, the stability of plane couette flow is discussed and the analysis is restricted to long wave approximation. The results are discussed for various dimensionless parameters with the support of graphs.

In Chapter IV, stability analysis is performed for non-parallel stratified shear flows of an inviscid, incompressible fluid with Hall current effect. Here, the magnetic field is assumed to be large enough to produce significant Hall current. The fluid layer is subjected to a uniform external magnetic induction.. The plates at $z = \pm L$ are assumed to be electrically non-conducting.

In Chapter V, the linear stability of stratified shear flow between two plates at a distance 2L is studied by considering the varying magnetic field. The analysis is performed using normal mode analysis. The behavior of various flow characteristics due to dimensionless parameters are discussed using graphs.

Chapter VI is to investigate the effect of uniform magnetic field on the stability of a stratified flow between two infinite plates with linear shear velocity profile. Asymptotic solutions are obtained using perturbation techniques for velocity and growth rate. The effects of various dimensionless parameters are analyzed with graphs.

In Chapter VII, the rotation effect on the stability of parallel stratified shear flows is investigated. Governing equations for the flow are solved and numerical analysis is carried out to study the effect of various nondimensional parameters on growth rate and on velocity and the results are depicted graphically.

In Chapter VIII, the stability analysis of an inviscid, incompressible rotating stratified non-parallel shear flow is performed. The stability of the flow was analyzed using normal mode approach and the analysis was restricted to long wave approximations. Also, the performances of various dimensionless parameters encountered in this problem are discussed with the help of graphs.

Chapter IX presents the brief summary of the results obtained from the above mentioned works.

In all the problems mentioned above, the equation of continuity, equation of motion, equation of state and Maxwell's equations are considered. The governing equations are solved using perturbation technique. We obtain the linearized equations governing the dynamics of the perturbations by neglecting higher order terms of wave number. These linearized equations are solved by incorporating normal mode analysis. Analytical solutions are found for eigen functions and eigen values using long wave approximations.

Nomenclature

Nomenclature

$\vec{q}$	Velocity vector of the fluid
μ	Dynamic Viscosity
ρ	Density of the fluid
υ	Kinematic viscosity
g	Gravitational acceleration
L	Characteristic length
U_0	Characteristic velocity
p	Pressure of the fluid
$\vec{J}$	Total electric current density
$\vec{B}$	Magnetic flux
σ	Electrical conductivity
μ_m	Magnetic permeability
Ri	Richardson number
Ω	Angular velocity of rotation
N	electron number density
e	charge of an electron
H_0	magnetic field strength
Rm	Magnetic Reynolds number
N^2	Brunt-Vaisala frequency
η	Magnetic resistivity
ρ_0	Mean density
S	Magnetic pressure number
k	longitudinal wave number
l	transverse wave number
σ	complex wave velocity
τ	Rotation number
M	Hall parameter
Ha	Hartmann number