Faculty of Engineering
Ain Shams University

HYDROMAGNETIC STABILITY OF COMPRESSIBLE SELF-GRAVITATIONAL FLUID CYLINDER

Thesis Submitted in Partial Fulfillment
for Ph.D. Degree in Engineering Mathematics

By
Eng. ALFAISAL ABDELHAMEED MOHAMED HASAN
Assistant Lecturer in Engineering Physics and Mathematics Department,
Faculty of Engineering (Mataria), Helwan University, Cairo, Egypt

Supervisors

Prof. Dr. TALAT F. REFAI
Professor of Engineering Mechanics
Engineering Physics and Mathematics Department,
Faculty of Engineering,
Ain Shams University, Cairo
Egypt

Prof. Dr. AHMED E. RADWAN
Professor of Applied Mathematics
Department of Mathematics
Faculty of Science,
Ain Shams University, Cairo
Egypt

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Faculty of Engineering,
Ain Shams University,
Cairo, Egypt

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Examination Committee

Prof. Dr. Nabil Tawfeek Eldabe ----------
Professor of Applied Mathematics
Ain Shams University, Cairo, Egypt

Prof. Dr. Abdelrahman Hussein Essawy ----------
Professor of Applied Mathematics
Minia University, Cairo, Egypt

Prof. Dr. Talat Fawzy Refai ----------
Professor of Engineering Mechanics
Ain Shams University, Cairo, Egypt

Prof. Dr. Ahmed El-Azab Radwan ----------
Professor of Applied Mathematics
Ain Shams University, Cairo, Egypt

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جامعة عين شمس
كلية الهندسة
قسم الرياضيات والفيزيقا الهندسية

رسالة دكتوراة الفلسفة في الرياضيات الهندسية

إسم الباحث: الفيصل عبدالحميد محمد حسن

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لجنة الإشراف

الأسماء	الوظائف
أ.د./ طلعت فوزى رفاعى	أستاذ الميكانيكا الهندسية كلية الهندسة – جامعة عين شمس
أ.د./ أحمد العزب رضوان	أستاذ الرياضيات التطبيقية كلية العلوم – جامعة عين شمس

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إسم الباحث: الفيصل عبد الحميد محمد حسن

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بسم الله الرحمن الرحيم

" يسبح لله ما في السموات وما في الأرض الملك القدوس العزيز الحكيم (1) هو الذي بعث في الأميين رسولاً منهم يتلوا عليهم آياته ويعلمهم الكتاب والحكمة وإن كانوا من قبل لفي ضلال مبين (2) وآخرين منهم لما يلحقوا بهم وهو العزيز الحكيم (3) ذلك فضل الله يؤتيه من يشاء والله ذو الفضل العظيم (4) "

سورة الجمعة (1-4)

STATEMENT

This dissertation “Hydromagnetic Stability of Compressible Self-Gravitational Fluid Cylinder” is submitted to the Faculty of Engineering, Ain-Shams University, for the Doctorate of Philosophy in Engineering Mathematics.

The work included in this thesis has been carried out by the author in the department of Physics and Engineering Mathematics, Faculty of Engineering, Ain Shams University, from (2006) to (2009).

No part of this thesis has been submitted for a degree or a qualification at any other Universities or Institutions.

Date:

Signature:

Author: Alfaisal AbdelHameed Mohamed Hasan.

To my family

My deep appreciation goes to my parents to whom I am always indebted. Their continuous encouragement and support will give me the impetus to excel in my work throughout my professional life. They are always wishing to see me finishing this work. Their words were pushing me and giving me the power to continue.

To my brothers and my sisters I will always be grateful for their encouragement.

To my precious kids Mariam, Omar and Habiba, without their smiles I could not be able to complete my life.

Finally, to my dear wife, She is always standing beside me since the beginning of this work, supporting, advising, and also helping in finishing this work. I will always be grateful although this is not enough.

Alfaisal AbdelHameed Mohamed Hasan

To my family

To my parents…..

……To my wife……

……To my precious kids Mariam, Omar and Habiba

Alfaisal Abdelhameed Mohamed Hasan

ABSTRACT

Name	**:**	**ALFAISAL ABDELHAMEED MOHAMED HASAN**
Title	**:**	**HYDROMAGNETIC STABILITY OF COMPRESSIBLE SELF-GRAVITATIONAL FLUID CYLINDER**
Degree	**:**	**Doctorate of Philosophy in Engineering Mathematics.**
Faculty	**:**	**Faculty of Engineering, Ain-Shams University**
Specialty	**:**	**Engineering Physics and Mathematics (Engineering Mathematics)**

Chapter (I) is an introduction, a brief discussion of the concept of stability and different techniques which may be used in stability problems analysis are introduced. Also the basic hydrodynamics and magnetohydrodynamics (MHD) equations which are essential for formulating any stability problem are presented. Different boundary conditions at the fluid interfaces are explained. Finally, some reported works in the hydrodynamics, electrohydrodynamics and magnetohydrodynamics stability of cylinders and jets are reviewed.

In Chapter (II), the stability of a fluid cylinder subject to the combined effect of the capillary, self-gravitating and electromagnetic forces for all axisymmetric and non–axisymmetric perturbation modes is investigated. The dispersion relation is derived and some reported works are recovered as limiting cases from it.

The results of this problem have been published in the International specialized Scientific Journal of "Applied Mathematical Modelling" (UK), 33(4) (2009) 2121-2131.

Chapter (III) is devoted to discussing the axisymmetric electrodynamic instability of a self-gravitating dielectric fluid cylinder, density ρ^i, ambient with a different self-gravitating dielectric fluid, density ρ^e. The eigenvalue relation has been established and studied analytically and the results are confirmed numerically. The electrodynamic force has effective effect on the dielectric system and this is physically explained. The density ratio $\left(\rho^e/\rho^i\right)$ has a stabilizing effect. Also the ε ratio $\varepsilon\left(=\varepsilon^e/\varepsilon^i\right)$ has a stabilizing influence.

The results of this problem have been published in "Al-Azhar Engineering Tenth International Conference", Vol. P03 (2008) 12-21.

In Chapter (IV), the electrogravitational instability of a dielectric fluid cylinder surrounded by medium of negligible motion pervaded by varying transverse oscillating electric field has been investigated in the axisymmetric perturbation. The acting forces on the model are: self-gravitating, pressure gradient and electrodynamic forces. The model is governed by Mathieu second order integro-differential equation. Some limiting cases are recovered from the present general one.

The results of this problem have been published in the International specialized Scientific Journal of "(IA ENG) International Journal of Applied Mathematics (UK)", 38(3) (2008) 113-120.

In Chapter (V) we have studied the MHD stability of a gravitational medium with streams of variable velocity distribution for a general wave propagation in the present of the rotation forces. The magnetic field has strong stabilizing influence but the streaming is a destabilizing. The rotating forces have a stabilizing influence under certain restrictions. It is proved that the gravitational Jean's instability criterion is not influenced by the electromagnetic force or the rotation force or even by the combined effect of them whether the fluid medium is streaming or not and whether the rotation in one or more dimension.

Keywords:

Electrogravitational - Fluid cylinder - Magnetohydrodynamic-
Selfgravitating - Stability.

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