



بسم الله الرحمن الرحيم



# شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



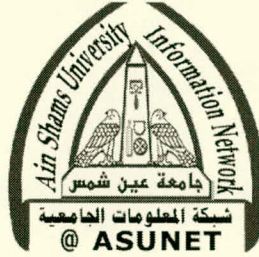
شبكة المعلومات الجامعية

# جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

## قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
علي هذه الأفلام قد أعدت دون أية تغيرات



## يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of  
15-25- c and relative humidity 20-40%



# بعض الوثائق الأصلية تالفة

# بالرسالة صفحات لم ترد بالاصل

TANTA UNIVERSITY  
FACULTY OF SCIENCE  
DEPARTMENT OF MATHEMATIC



# A Study in stability of a fluid layer under the influence of external forces

## A Thesis

Submitted to the Department of Mathematics,

Faculty of science, Tanta University

In partial fulfillment of the requirements of

The award of the M. Sc. Degree

BY

**Mansour Abd-EL-warith El-Safty**

## Supervisors

**Dr. Ahmed El-Meligy Mahfouz**

Ass. Prof. of Applied Mathematics  
Faculty of science, Tanta University.

**Dr. Kadry Zakaria**

Ass. Prof. of Applied Mathematics  
Faculty of science, Tanta University

2007

Handwritten signature and date.



## Supervisors

**\* Dr. Ahmed El-Meligy Mahfouz**

Ass. Professor of Applied Mathematics,

Faculty of science, Tanta University.

**\* Dr. Kadry Zakaria**

Ass. Prof. of Applied Mathematics,

Faculty of science, Tanta University.



**Head of Mathematics Department**

**Prof. Dr. M. Beltagy.**



Faculty of science, Tanta University.

## Curriculum Vitae

**Name** : Mansour Abd-El-Warith Mansour El-Safty.

**DOB** : 04/06/1970.

**Gender** : Male.

**Religion** : Moslem.

**Nationality** : Egyptian.

**E-Mail** : [elsafty010@yahoo.co.uk](mailto:elsafty010@yahoo.co.uk).

**Phone** : 0102978152&0227872087.

**Current Job** : Teacher of Math. in Cairo, in Ministry Education.

### Qualification:

\*B.SC. Degree in Mathematics, Egypt, May 1992, with a grade "Good", Faculty of science, Tanta University.

### Awards:

\*Certificate of merit, from more Schools, in Ministry of Education, for his activity in the Schools.

\*Certificate from Faculty of Commerce, Tanta University, Egypt, for special program in computer training for graduate studies and research, May 2001 with Grade "Good".

\*Certificate of merit, from the center of training in Mumbark city for Education, Cairo, in ICDL for computer NO1 in July 27, August 20, 2002.

\*Certificate of merit, from the American University, Cairo for the Professional continuing Education course TOEFL preparation "II" July 27, August 20, 2002.





\*Certificate from Faculty of Education, Strathclyde University Glasgow, Scotland, UK, for Egyptian Teacher of Mathematics training course, from Sept.18 to Dec. 2002, with a Grad "Excellent".

\*Certificate from Faculty of Education, Strathclyde University Glasgow, Scotland, UK, for Egyptian Teacher of Mathematics training course, in EFL in English from Sept.18 to Dec. 2002, with a Grad "Excellent".

**Experience:**

\*He resumed his work for the first time on May 15, 1995, after finishing his Military service and he is still working in the School. He has been working with us as Mathematic Teacher in the School.

\*Training course in Mathematic in UK, from Sept.18 to Dec. 2002. The course included:

- Modern teaching Methodology in Mathematics.
- Educational & Information Technology.
- Curriculum development in UK Mathematics Education.

**Head of Mathematics Department**

**Prof. Dr. M. Beltagy.**

*M. Beltagy*  
Faculty of science, Tanta University.

# ***ACKNOWLEDGEMENT***

## ACKNOWLEDGMENT

All gratitude and thankfulness to Allah almighty that guided and aided me to bring this work to existence.

It is a pleasure to express my science thanks to my supervisor **Dr. Ahmed El-meligy Mahfouz**, Assistant Professor of Applied Mathematics, Faculty of science, Tanta University, for his help.

I would like to express my deep appreciation to my supervisor **Dr. Kadry Zakaria**, Assistant Professor of Applied Mathematics, Faculty of science, Tanta University, for suggesting the problems involved in this work and for his helpful guidance and facilities he offered through out the preparation of this thesis, valuable suggestions and discussions throughout his supervision of his work.

I would also like to express my deep gratitude's to **Professor Dr. Mohamed Beltagy**, the Head of the Department of Mathematics, Faculty of science, Tanta University, for his help.

I am deeply indebted to **Professor Dr. Mohamed Ezzat Abd El-Monsef**, the previous Dean of the Faculty of science, to **Professor Dr. Entesar El-Kholy**, the previous Head of Department of Mathematics, Tanta University.

I am very grateful to my **Dr. Magdy Ali Sirwah**, the lecturer of Applied Mathematics, Faculty of science, Tanta University, for his stimulating advice and his facilities for performing and finishing this work.

My thanks also are to the staff of the Department of applied, Pure Mathematics and others, Faculty of science, Tanta University, for the facilities given to me and also my friends.

**Mansour El-Safty**  
**Elsafty010@yahoo.co.uk**

## Postgraduate Studies

The present thesis is submitted to Mathematics Department, Faculty of science, Tanta University in Partial Fulfillment of requirements of the Degree of Master of science in Applied Mathematics.

Besides the research work materialized in this thesis, the candidate has attended six postgraduate courses including the following topics:

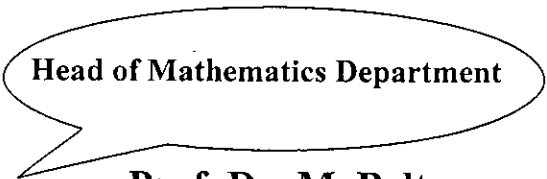
- (1) Quantum Mechanics part "I".
- (2) Aerodynamics and Fluid.
- (3) Deutsch.
- (4) Quantum Mechanics part "II".
- (5) Theory of Elasticity.
- (6) Course of Computer science.

The applicant **MANSOUR ABD-EL-WARITH EL-SAFTY** has successfully passed the final examination of these courses.

### SUPERVISORS

**Dr. Ahmed El-Meligy Mahfouz**  
Ass. Prof. of Applied Mathematics  
Faculty of science, Tanta University.

**Dr. Kadry Zakaria**  
Ass. Prof. of Applied Mathematics  
Faculty of science, Tanta University



**Head of Mathematics Department**

**Prof. Dr. M. Beltagy.**

Faculty of science, Tanta University.

# ***Contents***



# CONTENTS

## LIST OF FIGURES

### Abstract

## CHAPTER I

### INTRODUCTION

<b>(1.1) Definitions</b>	1
(1.1.1) The Fluid Mechanics	1
(1.1.2) The Interfacial Wave motion	2
<b>(1.2) The Ferrohydrodynamics (FHD)</b>	11
<b>(1.3) The Magnetic Fluid</b>	13
<b>(1.4) The Mechanical Equations</b>	14
(1.4.1) Maxwell Equations	14
(1.4.2) Basic Equations of magnetic fluids	16
(1.4.2.1) Equations of motion for a magnetic fluid	16
(1.4.2.2) Boundary Conditions	19
<b>(1.5) The Hydrodynamic Stability</b>	21
(1.5.1) the Linear Hydrodynamic Stability	23
(1.5.2) Rayleigh- Taylor Instability	24
(1.5.3) Kelvin- Helmholtz Instability	26
<b>(1.6) The Stability of three- layer system</b>	30
<b>(1.7) The method of multiple scale</b>	37
<b>(1.8) Mathieu Equation</b>	41

## **CHAPTER II**

### **Stability of a magnetic layer in the presence of an oblique magnetic field**

<b>(2.1) Introduction</b>	<b>45</b>
<b>(2.2) Formulation of the problem</b>	<b>47</b>
(2.2.1) Basic Equations	47
(2.2.2) Boundary Conditions	52
<b>(2.3) The Derivation of the characteristic equations</b>	<b>53</b>
<b>(2.4) The Stability analysis</b>	<b>57</b>
(2.4.1) The Stability of the Kelvin-Helmholtz problem	58
(2.4.2) The Stability of the Rayleigh-Taylor problem	58
<b>(2.5) Conclusion</b>	<b>69</b>

## **CHAPTER III**

### **Stability of a fluid layer under the effect of a periodic magnetic field**

<b>(3.1) Introduction</b>	<b>72</b>
<b>(3.2) Stability analysis with a periodic</b>	<b>73</b>
<b>(3.3) The Zero-order problem</b>	<b>75</b>
<b>(3.4) The first -order problem</b>	<b>77</b>