شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

# بسم الله الرحمن الرحيم

MONA MAGHRABY

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# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

## قسم

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

## يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

***MONA MAGHRABY***

**Ain Shams University**
**University College for Women**
**(Arts, Science, and Education)**
**Department of Mathematics**

# QUANTUM ENTROPY FOR A NON-LINEAR INTERACTION SYSTEMS.

A THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE (M.Sc.)
(APPLIED MATHEMATICS)

**BY**

**Esraa Salem Abdel-Hameed Salem Elkhouly**

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**Prof. Dr. Mohamed Mohamed Ali Ahmed**
Professor Emeritus of Applied Mathematics
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**( 2021 )**

**Ain Shams University**
**University College for Women**
**(Arts, Science, and Education)**
**Department of Mathematics**

M.Sc. Thesis
(APPLIED MATHEMATICS)

Title of Thesis:

# QUANTUM ENTROPY FOR A NON-LINEAR INTERACTION SYSTEMS.

Thesis supervisors:

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**University College for Women**
**(Arts, Science, and Education)**
**Department of Mathematics**

# COURSES

**The student has passed the following courses in partial fulfillment of requirement for M. Sc. degree:**

| | | |
|---|---|---|
| 1. | **Quantum Theory.** | **3h per week** |
| 2. | **Complex Analysis.** | **3h per week** |
| 3. | **Numerical Analysis.** | **3h per week** |
| 4. | **Writing Scientific Research.** | **3h per week** |
| 5. | **Partial Differential Equations.** | **3h per week** |
| 6. | **Relativity Quantum mechanics .** | **3h per week** |
| 7. | **Computational Methods in Applied Mathematics.** | **3h per week** |
| 8. | **Ethics of Scientific Research.** | **3h per week** |

Head of Mathematics Department

# Dedicated to

To my paradise, happiness and the closest to my heart, my father and my mother, they were help and support for me, and their blessed supplications had the greatest influence on my reaching this stage.

To my dear sisters, may Allah grant them success in their academic journey.

To everyone who taught me a letter, word, or sentence that increased my educational achievement.

I dedicate to you the result of my effort.

May , 2021..... *ESRAA. S. ELKHOULY*

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May , 2021..... *ESRAA. S. ELKHOULY*

# List of publications

[1] E.S. ELKHOULY, A.A. EIED, M.M.A. AHMED and A-S.F. OBADA (Quantum Entropy and Collapses-revivals Phenomenon for a Generalized Four-level Atom Interacting with a Single-mode Field with Nonlinearities) *Nonlinear Optics and Quantum Optics,* ***53****(1-2), (2021):13-29.*

[2] A-S.F. OBADA, M.M.A. AHMED, E.S. ELKHOULY and A.A. EIED (Effects of Damping and Stark Shift on a Nonlinear Interaction Between a $\Lambda$-type Three-Level atom and a single-Mode Cavity Field). Submitted for publication in *Modern Physics Letters A*.

[3] A-S.F. OBADA, M.M.A. AHMED, E.S. ELKHOULY and A.A. EIED (A Study of a Nonlinear Interaction Between a Two-Mode Cavity Field and $\diamondsuit$-type four-level with Field Damping). Submitted for publication in *Modern Physics Letters A*.

[4] E.S. ELKHOULY, A.A. EIED, M.M.A. AHMED and A-S.F. OBADA (Quantum Entropy and Collapses-revivals Phenomenon for a Generalized Four-level Atom Interacting with a Single-mode Field with Nonlinearities) *the* $4^{th}$ *CIC s Multidisciplinary International Conference* 2019.