شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

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 الوثائـــــــق الاصليـــــة تالفـــة

بالرسالة صفحات لم ترد بالاصل

NUMERICAL METHODS FOR SOLVING SOME PARABOLIC EQUATIONS

THESIS

Submitted in partial Fulfillment for the degree
OF
MASTER OF SCIENCE
IN
PURE MATHEMATICS

By

IHAB AHMED EL-SAYD ALI

Department of Science and Mathematics
Faculty of Petroleum and Mining Engineering
Suez Canal University

Submitted to

Department of Mathematics
Faculty of Science
Suez Canal University

Supervised by

Dr. Sherif Ibrahim Zaki
Assoc. Prof. of Comp. Science
Suez Canal University

Dr. Ahmed K. A. Khalifa
Assoc. Prof. of Math
Al-Azhar University

2000

Suez Canal University
Faculty of Science
Department of Mathematics

Title of Thesis

" NUMERICAL METHODS FOR SOLVING SOME PARABOLIC EQUATIONS "

By
Ihab Ahmed El-sayed

Examiners Committee	***Signature***
Prof. Dr. Ismail Amr Ismail Prof. of Mathematics Faculty of Computer Science *El-Zagazieg University*	
Prof. Dr. Ahmed Hassan Ali Prof. of Pure Mathematics Math. Dept., Faculty of Science Menoufia University	
Dr. Ahmed K. A. Khalifa Assoc. Prof. of Pure Mathematics Math. Dept., Faculty of Science Al-Azhar University	

Suez Canal University
Faculty of Science
Department of Mathematics

Thesis

Submitted for the

Master Degree in Science in

Pure Mathematics

Title of Thesis

" NUMERICAL METHODS FOR SOLVING SOME PARABOLIC EQUATIONS "

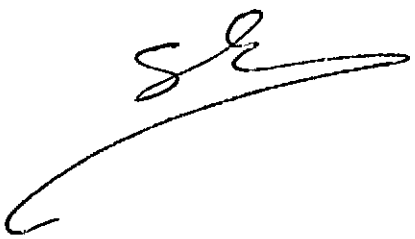
By

Ihab Ahmed El-Sayed Ali

Supervisors **(Signature)**

Dr. Sherif Ibrahim Zaki

Assoc. Prof. of Comp. Science
Math. Dept., Faculty of Science
Suez Canal University



Dr. Ahmed K. A. Khalifa

Assoc. Prof. of Pure Mathematics
Math. Dept., Faculty of Science
Al-Azhar University

2000

ACKNOWLEDGMENT

I would like to express my sincere gratitude to Dr. Ahmed K. A. Khalifa, for his constant interest in this work. Without his assistance this work would have not been accomplished.

I wish to express my appreciation and gratitude to Dr. Sherif Ibrahim Zaki, for his kind approval to supervise research and for his continuous valuable advise, guidance and encouragement.

Special thanks are devoted to all the department of mathematics members, Faculty of Science, Al-Azhar University for their help and continuous encouragement.

Summery

In this thesis we are devoted to applying the spectral methods with different basis functions, for studying some linear (Heat equation) and nonlinear (Burgers' equation) Parabolic equations.

Theoretical background as well as, detailed informations for the numerical schemes used in solving these equations are given. Most of the previous work on these equations was devoted to finite difference and finite element methods. Spectral methods are also used but widely with Chebyshev polynomials as basis for the space of solution.

In present work we extend our applications to the use of Legendre polynomials as basis. The necessary formulas for the method were concluded and shown in details throughout this thesis.

Also the resulting systems of algebraic equations were handled in two different ways as to obtain better numerical results.

We have concluded that spectral methods are good and convenient for such problems, and better results are obtained in case of using Legendre polynomials rather than the widely used Chebyshev polynomials. We feel that these results can give rise to apply the scheme to different linear and nonlinear problems.

CONTENTS

Introduction

In this thesis, we present and apply the spectral method to get the numerical solution of some parabolic equations. Such equations appear frequently in Physics and Engineering representing various Phenomena's. In our discussions we have considered (with test examples) linear and nonlinear parabolic equations. Formulations of the numerical schemes are presented with the supporting theoretical informations, different basis Polynomials (Chebyshev and Legendre) for the space of solution are considered such as to compute the numerical solution.

Chapter one gives a review about the types of the equations we are dealing with, and it includes a brief introduction to finite difference and spectral methods that are mainly used in this thesis, in addition to some types of orthogonal polynomials (Chebyshev and Legendre) and their properties as necessary for applications.

Chapter two presents the application of the spectral method to the simple heat equation using Chebyshev and Legendre Polynomials as basis. The necessary formulas for obtaining the coefficient derivatives (1^{st} and 2^{nd}) which relate the Polynomial derivatives with their values are given in details. A test example is considered and the numerical results are shown with graphs.

Chapter three deals with Burgers' equation as nonlinear parabolic equation, and considers the spectral method with Chebyshev Polynomials. The resulting algebraic system of equations is solved by two different techniques and the numerical results are presented in addition to graphs for the solution.

Chapter four is devoted to applying the spectral method with Legendre Polynomials as basis to solve the Burgers' equation. The necessary relations in this case as will be shown in chapter two are used. Other relations for expressing the product of two Polynomials in terms of the Polynomials will also be stated. The application of the method is suited and the numerical results are shown to be better than the previous case, in chapter three.

In chapter five we give a brief discussion of the material presented in this thesis. A comparison between the different schemes discussed in this thesis is presented and a conclusion is given. All computations were carried out on a Pentium 75 PHILIPS. Computer.

CHAPTER ONE