# CONTENTS

**ACKNOWLEDGEMENTS**

**ABSTRACT**

**ABSTRAK**

**CONTENTS**

## CHAPTER 1  INTRODUCTION
1.1 Background Of The Study
1.2 Objective Of The Research
1.3 Outline Of The Report

## CHAPTER 2  LITERATURE REVIEW
2.1 Introduction
2.2 Nitrogen Laser
2.3 Fast Electrical Discharge Pumping Method
   2.3.1 Capacitor Transfer Circuit
2.4 Electrical Breakdown In Gaseous Medium
   2.4.1 Townsend Breakdown Mechanism
   2.4.2 First And Second Townsend Coefficients
   2.4.3 Space Charge Effect And Plasma Streamer Formation
   2.4.4 Cathode Sheath Formation
2.5 Modeling The Plasma In The Gas Discharge
   2.5.1 Plasma With Resistive And Inductive Effects
   2.5.2 The Resistance Of The Discharge Under Uniform Electrical Discharge
2.6 The Fluid Behavior Of The Plasma
   2.6.1 Continuity Equations In Physics
   2.6.2 Requirement For Finite-Difference Algorithms
   2.6.3 The Principles Of Flux-Corrected Transport (FCT) Algorithm
2.6.3.1 Introduction 18
2.6.3.2 Positivity And Accuracy 18
2.6.4 The Basic Idea Of Flux-Corrected Transport (FCT) 20
2.6.4.1 The Transport Stage 21
2.6.4.2 The Antidiffusion Stage 22
2.7 Discharge Current Induced By The Motion Of The Charged Particles 25

CHAPTER 3 METHODOLOGY AND NUMERICAL SIMULATION
3.1 Introduction 30
3.2 Circuit Equations 30
3.2.1 Fourth-Order Runge-Kutta Method (RK-4) 32
3.2.2 Numerical Solution Of The Circuit Equations 32
3.3 The Study Of The Electrical Field 35
3.3.1 Uniform Electrical Field 35
3.3.2 Non-Uniform Electrical Field 35
3.3.3 Poisson Equation 36
3.4 Local Electrical Field Between The Elongated Parallel Plates 36
3.4.1 Simulation Of The Electrical Field Variation 39
3.5 Phoenical LPE SHASTA Flux Corrected Transport 39
3.5.1 Diffusion Coefficients And Low Phase Errors 39
3.5.2 Numerical Solution Of Phoenical LPE SHASTA Flux-Corrected Transport 40
3.6 Townsend Ionization Process In The Discharge Medium 41
3.6.1 Fluid Equations With Source Term 42
3.6.2 Numerical Solution Of The Source Term In The Fluid Equation 43
3.6.3 Boundary Condition Of The Fluid Equation 44
3.6.4 Initial Setting Of The Swarm Parameters 45
3.7 Sato’s Equation As The Solution Of The Discharge Current 46
3.8 Numerical Algorithm 46
CHAPTER 4  RESULTS AND DISCUSSIONS

4.1 Solution Of The Continuity Equation Using The FCT algorithm 49
4.2 The Fluid Equation With The Source Terms 53
4.3 The Characteristics Of The Electrical Discharge Under Uniform Electrical Field Simulation 55
4.4 The Study Of Non-Uniform Electrical Field 60
  4.4.1 The Distribution Of The Charge Carriers And The Local Electrical Field Variation Under The Space Charge Effect 60
  4.4.2 The Important Role Of The Ion Bombardment Process As The Secondary Emission Effect In The Breakdown Process 66
  4.4.3 The Space Charge Effects And The Electrical Discharge Characteristics 71
4.5 The Influence Of The External Electrical Discharge Circuit 73
  4.5.1 The Spark Gap Properties. 73
4.6 The Influence Of Gas Pressure 78

CHAPTER 5  CONCLUSION

5.1 Conclusion 81

REFERENCES 83