CONTENTS

PAGE

ENGLISH ABSTRACT ii

THAI ABSTRACT iii

ACKNOWLEDGEMENT iv

CONTENTS v

LIST OF TABLES viii

LIST OF FIGURES ix

LIST OF TECHNICAL VOCABULARY AND ABBREVIATIONS x

CHAPTER

1. INTRODUCTION 1

1.1 Rational 1

1.2 Literature Review 1

1.3 Objective of the Thesis 2

1.4 Scopes of the Thesis 2

2. THEOREM 3

2.1 Radial Basis Functions (RBFs) Method 3

2.2 Integrated Radial Basis Functions (IRBFs) 6

2.3 Biharmonic Equation 6

3. METHODOLOGY 7

3.1 Finite difference approximation of biharmonic equation with 2^{nd} order accuracy. 7

3.1.1 The finite difference approximation of $\left.\frac{\partial^4 u}{\partial x^4}\right|_{i,j}$ with 2^{nd} order accuracy. 7

3.1.2 The finite difference approximation of $\left.2\frac{\partial^4 u}{\partial x^2 \partial y^2}\right|_{i,j}$ with 2^{nd} order accuracy. 8

3.1.3 The finite difference approximation of $\left.\frac{\partial^4 u}{\partial y^4}\right|_{i,j}$ with 2^{nd} order accuracy. 9

3.2 Finite difference approximation of biharmonic equation with 4^{th} order accuracy. 9

3.2.1 The finite difference approximation of $\left.\frac{\partial^4 u}{\partial x^4}\right|_{i,j}$ with 4^{th} order accuracy. 9

3.2.2 The finite difference approximation of $\left.2\frac{\partial^4 u}{\partial x^2 \partial y^2}\right|_{i,j}$ with 4^{th} order accuracy. 12

PAGE

3.2.3 The finite difference approximation of $\left.\frac{\partial^4 u}{\partial y^4}\right|_{i,j}$ with 4^{th} order accuracy. 12

3.3 Integrated Radial Basis Functions ($IRBF_s$). 15

3.4 Iteration Method 18

3.4.1 Iteration method of Finite Difference Method (FDM) with 2^{nd} order accuracy. 18

3.4.2 Iteration method of Finite Difference Method (FDM) with 4^{th} order accuracy. 19

3.4.3 Iteration method of Integrate Radial Basis Functions (IRBFs) 20

3.5 Boundary Condition 20

3.5.1 Backward difference approximation of $\left.\frac{\partial u}{\partial x}\right|_{i=N,j}$ with 2^{nd} order accuracy. 20

3.5.2 Backward difference approximation of $\left.\frac{\partial u}{\partial y}\right|_{i,j=N}$ with 2^{nd} order accuracy. 21

3.5.3 Forward difference approximation of $\left.\frac{\partial u}{\partial x}\right|_{i=N,j}$ with 2^{nd} order accuracy. 21

3.5.4 Forward difference approximation of $\left.\frac{\partial u}{\partial y}\right|_{i,j=N}$ with 2^{nd} order accuracy. 22

3.5.5 Backward difference approximation of $\left.\frac{\partial u}{\partial x}\right|_{i=N,j}$ with 4^{th} order accuracy. 23

3.5.6 Backward difference approximation of $\left.\frac{\partial u}{\partial y}\right|_{i,j=N}$ with 4^{th} order accuracy. 24

3.5.7 Forward difference approximation of $\left.\frac{\partial u}{\partial x}\right|_{i=N,j}$ with 4^{th} order accuracy. 25

3.5.8 Forward difference approximation of $\left.\frac{\partial u}{\partial y}\right|_{i,j=N}$ with 4^{th} order accuracy. 26

4. RESULTS AND DISCUSSION **27**

4.1 Example1 27

4.2 Example2 31

5. CONCLUSION AND RECOMMENDATION **35**

5.1 Conclusion 35

5.2 Recommendation 35

PAGE

REFERENCES **36**

APPENDIX **38**

BIOGRAPHY **52**

LIST OF TABLES

TABLE		PAGE
1.1	Some commonly used radial basis functions.	4
4.1	The result of example 1 by using FDM 13-point stencil and FDM 25-point stencils.	29
4.2	The result of example 1 by using FDM 25-point stencil and IRBFs 5-point stencils.	30
4.3	The result of example 2 by using FDM 13-point stencil and FDM 25 point stencils.	33
4.4	The result of example 2 by using FDM 25-point stencil and IRBFs 5-point stencils.	34

LIST OF FIGURES

FIGURE		PAGE
3.1	Diagram of biharmonic equation with 2^{nd} order accuracy.	9
3.2	Diagram of $\left.\frac{\partial^4 u}{\partial x^4}\right\|_{i,j}$ with 4^{th} order accuracy.	11
3.3	Diagram of $\left. 2\frac{\partial^4 u}{\partial x^2 \partial y^2}\right\|_{i,j}$ with 4^{th} order accuracy.	12
3.4	Diagram of $\left.\frac{\partial^4 u}{\partial y^4}\right\|_{i,j}$ with 4^{th} order accuracy.	14
3.5	Diagram of biharmonic equation with 4^{th} order accuracy.	14
3.6	Schematic outline of a 5-point stencil.	15
3.7	Diagram of iteration method biharmonic equation at 2^{nd} order accuracy.	19
3.8	Diagram of iteration method biharmonic equation with 4^{th} order accuracy.	19
4.1	Surface of exact solution of example 1	27
4.2	Surface of compact Finite Difference Method 13-point stencil of example 1.	28
4.3	Surface of compact Finite Difference Method 25-point stencil of example 1.	28
4.4	Surface of Integrated Radial Basis Functions 5-point stencil of example 1.	29
4.5	Surface of exact solution of example 2	31
4.6	Surface of compact Finite Difference Method 13-point stencil of example 2.	32
4.7	Surface of compact Finite Difference Method 25-point stencil of example 2.	32
4.8	Surface of Integrated Radial Basis Functions 5-point stencil of example 2.	33

LIST OF TECHNICAL VOCABULARY AND ABBREVIATIONS

D	=	Flexural rigidity
h	=	Grid size
n	=	Distant data
$\boldsymbol{n}$	=	Outward unit normal vector to the boundary Γ
C_k	=	Constant of integration
$G_k(x), \phi(r)$	=	Radial Basis Functions
$H_k(x), \overline{H}_k(x)$	=	Integrated Radial Basis Functions
β	=	Factor
ε	=	Shape parameter
τ	=	Time step
q_0	=	Intensity of the load at center of the plate
$a_k^{\,2}$	=	Multiquadric width
w_k	=	Weight of node k
$\overline{u}$	=	Prescribed potential on essential Γ_u
$\overline{q}$	=	Normal flux on essential Γ_q
∇^2	=	Two-dimensional Laplace operator
$\|\cdot\|$	=	Euclidean norm