

TABLE OF CONTENTS

Certificates	iii, v, vii
Acknowledgments	ix-xi
Abstract	xv-xviii
Table of contents	xix-xxi
List of figures	xxiii-xxviii
List of tables	xxix
List of abbreviations and symbols	xxxi-xxxiv
Chapter-1 Introduction	1-12
1.1. Free convection	1
1.2. Classification of free convection	2
1.3. Application of free convection	3
1.4. Factors affecting external free convection	3
1.5. Motivation and objectives	7
1.6. Thesis outline	11
Chapter-2 Literature Survey	13-28
2.1. Flow over a heated flat plate	13
2.1.1. Flow over a vertical plate	14
2.1.2. Flow over inclined plates	20
2.1.3. Flow over horizontal and slightly inclined flat plates	24
Summery	27
Chapter-3 Particle Image Velocimetry	29-38
3.1. Working principle of PIV	29
3.2. PIV subsystems	30

3.2.1. Seeding particles	30
3.2.2. Imaging	33
3.2.3 Illumination	35
3.2.4. Image processing	36
Chapter-4 Flow Over a Vertical Flat Plate	39-63
4.1. Theoretical background	39
4.2. Experimental details	42
4.2.1. Free convection setup	42
4.2.2. PIV technique for velocity measurement	45
4.3. Results and discussion	51
4.3.1. Temperature measurement	51
4.3.2. Velocity contours and streamlines	52
4.3.3. Velocity Profiles	53
4.3.4. Comparison of experimental and analytical results	58
4.3.5. Uncertainty analysis	62
4.4. Conclusion	62
Chapter-5 Flow Over Inclined Flat Plates	65-89
5.1. Experimental Details	65
5.1.1. Free convection setup	65
5.1.2. PIV technique for velocity measurement	69
5.2. Results and discussion	70
5.2.1. Hydrodynamic characteristics	71
5.2.2. Identification of onset of velocity transition	74
5.2.3. Comparison of different criteria	82

5.2.4. Wall shear stress	85
5.2.5. Thermal characteristics	86
5.3. Conclusion	88
Chapter-6 Flow over a Horizontal and Slightly Inclined Surface	91-116
6.1. Theoretical analysis	91
6.2. Experimental Details	92
6.3. Results and discussion	95
6.3.1. Velocity contours and streamlines	95
6.3.2. Identification of various regimes	96
6.3.3. Horizontal plate	100
6.3.3.1 Variation of u-velocity	100
6.3.3.2 Variation of v-velocity	106
6.3.4 Effect of inclination on flow structures	110
6.3.4.1. Lift-off point	110
6.3.4.2. Velocity boundary layer	112
6.3.4.3. Buoyant plume	113
6.4. Conclusion	115
Chapter-7 Conclusions and Scope for Future Work	117-120
7.1. Conclusion	117
7.2. Scope for future work	120
References	121-128
List of publications	129