CONTENTS

APPROVAL PAGE ii

SELF DECLARATION AGAINST PLAGIARISM iii

ABSTRACT iv

ACKNOWLEDGEMENTS v

PREFACE vi

CONTENTS vii

LIST OF FIGURES ix

LIST OF TABLES xi

CHAPTER I 1

1.1 Background 1

1.2 Problem Identification 3

1.3 Research Objectives 3

1.4 Hypothesis 4

1.5 Scope of Work 4

1.6 Research Methodology 5

CHAPTER II 7

2.1 Electric Vehicle (EV) 7

2.2 BLDC Motor 7

2.3 Regenerative Braking 8

2.4 Battery Degradation 10

2.5 Control System 11

2.6 Fuzzy Logic Control 12

2.7 Adaptive PID Control 14

2.8 Hybrid PID-Fuzzy Control 15

2.9 Metric Comparison 16
CHAPTER III 18
3.1 System's Model and Scenario 18
3.2 Simulation Scenario 22
3.3 Data Collection Scenarios 24
3.4 Analysis Scenario 25
CHAPTER IV 27
4.1 System Testing 27
4.2 Regenerative Braking System with No Control 30
4.3 Regenerative braking System with Fuzzy Logic Control 33
4.4 Regenerative Braking System with Adaptive PID 35
4.5 Regenerative Braking System with Hybrid Fuzzy-PID 38
4.5.1 SetPoint : 100, OutputRPM > 30 ON 38
4.5.2 SetPoint : 100, OutputRPM >10 ON 40
4.6 Summary of Results 44
CHAPTER V 49
REFERENCES 51