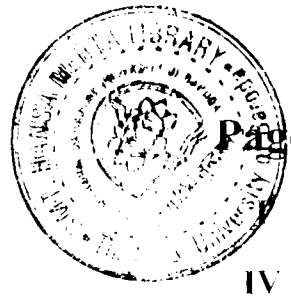
# CONTENTS




| Chapter | Title | Page |
|---|---|---|
| | **ABSTRACT** | I |
| | **TABLE OF CONTENTS** | IV |
| | **LIST OF FIGURES** | IX |
| | **LIST OF TABLES** | XI |
| | **NOMENCLATURE** | XIV |
| **1** | **Introduction** | **01** |
| 1.1 | Exergoeconomic Methodologies | 06 |
| 1.2 | Organization of the Thesis | 07 |
| **2** | **Review of Literature** | **09** |
| 2.1 | Exergy Analysis of Thermal Systems | 09 |
| | 2.1.1 Entropy Generation Minimization Method | 10 |
| | 2.1.2 Exergy Destruction Method | 19 |
| | 2.1.3 Comparison between EGM and EDM | 37 |
| 2.2 | Exergoeconomic Analysis | 37 |
| | 2.2.1 TEO Method | 40 |
| | 2.2.2 Theory of Exergetic Cost | 43 |
| | 2.2.3 Engineering Functional Analysis | 44 |
| | 2.2.4 Thermoeconomic Functional analysis | 45 |
| | 2.2.5 Structural Method | 46 |

2.2.6 Evolutionary programming 49

2.2.7 EEA method 50

2.2.8 Exergetic Production Cost method 51

2.2.9 Graphical Method 51

2.2.10 Input-Output Method 51

2.3 Problem Formulation 53

2.4 Objectives of the Research 54

**3 AAVAR System 61**

3.1 System Description 61

3.1.1 Chilling Unit 62

3.1.2 Condensing Unit 62

3.2 Other Options of Heat Energy Sources 66

3.2.1 Heat from GT-HRSG Plant as Heat Source 67

3.2.2 Tapped Steam from Steam Power Plant as Heat Source 68

3.3 Steady State Online Data 70

3.3.1 Online Data for Brine Chilling Unit 70

3.3.2 Online Data for GT-HRSG 71

3.3.3 Online Data for Steam Power Plant 72

**4 Exergoeconomic Optimization Methodology 74**

4.1 Exergy Analysis 74

4.1.1 Exergy Destruction Method (EDM) 75

4.1.2 Entropy Generation Minimization Method (EGM) 77
4.2 Exergoeconomic Analysis 77
4.2.1 Exergy Costing 78
4.2.2 Economic Analysis 80
4.2.3 Exergoeconomic Evaluation 83
4.3 Exergoeconomic Optimization 85
4.4 Unified Approach for Exergoeconomic Optimization 91

**5 Exergoeconomic Optimization of Existing System 95**

5.1 Exergy Analysis 95
5.1.1 System Simulation 95
5.1.2 EDM of Exergy Analysis 99
5.1.3 EGM Method of Exergy Analysis 107
5.2 Exergoeconomic Analysis 111
5.2.1 Levelized O&M Cost 112
5.2.2 Fuel Cost 121
5.2.3 Cost Flows 121
5.2.4 Exergoeconomic Evaluation 125
5.3 Exergoeconomic Optimization 129
5.3.1 Estimation of $B_k, n_k$ and $m_k$ 129
5.3.2 Optimization Through Case by Case Iterative Procedure for AAVAR system 141
5.3.3 Optimization through Iterative Procedure for Pre-coolers 1 and 2 146
5.3.4 Results and Discussions 149

| | | | |
|---|---|---|---|
| 6 | | **Exergoeconomic Optimization of Alternative Options** | **150** |
| | 6.1 | Steam Generated at HRSG as Heat Source | 150 |
| | | 6.1.1 System Simulation | 151 |
| | | 6.1.2 Exergy Analysis | 151 |
| | | 6.1.3 Exergoeconomic Analysis | 163 |
| | | 6.1.4 Exergoeconomic Evaluation | 166 |
| | | 6.1.5 Exergoeconomic Optimization | 168 |
| | 6.2 | Tapped Steam as Heat Source | 182 |
| | | 6.2.1 System Simulation | 182 |
| | | 6.2.2 Exergy Analysis | 189 |
| | | 6.2.3 Exergoeconomic Analysis | 194 |
| | | 6.2.4 Exergoeconomic Evaluation | 197 |
| | | 6.2.5 Exergoeconomic Optimization | 198 |
| | 6.3 | Comparison | 206 |
| 7 | | **Conclusions** | 209 |
| | | **References** | **213** |
| | | **Appendices** | |
| | | Appendix-A | 227 |
| | | Appendix-B | 231 |
| | | Appendix-C | 234 |
| | | Appendix-D | 237 |
| | | Appendix-E | 240 |
| | | Appendix-F | 242 |

Appendix-G 244
Appendix-H 247
Appendix-I 249

**Publication From This Work 250**

**Acknowledgement 251**