Chapter One

Introduction

1.1RESEARCH OVERVIEW

Internal combustion engines are the one of most important engines in practical life due to the board usage in various fields.Exact study and analysis for internal combustion engines is complex, the accurate analysis can be obtained experimentally when it will be carried out correctly and systematically. But it would be time consuming and very expensive. So the theoretical analysis is the alternative option to study the work of the engine without the need to conduct laboratory experiments. Theoretical analysis involves modeling and simulating of the engine operation with the help of thermodynamics to form mathematical expressions which is solved in order to obtain the relevant desired output parameters.Solving method of these equations will depend on the complexity of these equations, which in turn depends on the assumptions that have been developed for the analysis of processes in the engine. And therefore more assumptions mean facilitate the solution of these equations, but in this case would be less accurate analysis.

Air standard cyclesare often used as ideal cycle for internal combustion engine. In that case, air is assumed tobehave as an ideal gas, and all processes are considered to be reversible, there is no losses from system to thesurroundings, specific heats of gas are also kept constant though they change with temperatures. But actually the working substance in the engine is not only air, but a mixture of fuel and air and cannot be considered as an ideal gas; as well the impossible existence of reversible processes in the engine;as result of the presence of losses due to friction. Many researchers have worked on analysis of irreversible processes in internal combustion engines which include various losses with some assumptions.

There are many standard air cycles used in internal combustion engines, but the most important of these cycles is Joule-Brayton cycle, because it is used as startup in electricity power plants. So the Joule-Brayton cycle was selected to be the field of study in this research.

1.2 RESEARCH PROBLEM

Problemof this researchliesin the study the performance parameters of the engine that works according to the Joule-Brayton cycle mathematically by using finite time thermodynamics method taking into account the specific heat variation of the working fluid with temperature.

1.3 RESEARCH IMPORTANCE

Importance of this research lies in that a mathematical analysis of the engine performance does not consume time as it is cheap contrary to experiments.

1.4 RESEARCH OBJECTIVES

- ✓ Mathematically analyze the engine performance by using finite time thermodynamics and compare these results with those obtained by experiments.
- ✓ Study the effect of specific heat variation in the engine performance.

1.5 RESEARCH APPROACH

- ✓ This researchwill dependmainly onmathematical analysis.

1.6 METHODOLOGY

- ✓ Model formulation of Joule-Brayton cycle by prepares all the required equations for Joule-Brayton cycle that includes equations that show the relationship between the specific heat and temperature.
- ✓ Drafting a computer program using MATLAB software to solve equations of the model is to rely on iteration in this program, so

that given initial values of temperatures and other parameters to run the program.

- ✓ Taking the final values obtained from the program after making sure to check the accuracy in these values, these values are plotted charts in order to facilitate analysis.

1.7ANTICIPATEDRESULTS

- ✓ Using the results obtained from this research in the actual design of the engine.
- ✓ Identify the thermodynamic procedures that occur inside the engine better.

1.8THESIS LAYOUT

- ✓ **Chapter Two:** review the previous studies about finite-time thermodynamics and its applications in various thermodynamics cycles.
- ✓ **Chapter Three:** illustrates the theoretical framework or the topics related to finite-time thermodynamics.
- ✓ **Chapter Four:** shows the required equations for the thermodynamic model for joule-Brayton cycle considering the variability of specific heats for working fluid.
- ✓ **Chapter Five:** discussion of the obtained results from the thermodynamic model illustrated in chapter four.
- ✓ **Chapter Six:**concludes the final results and the research outputs leading to recommendations on the validity of results to be used in the engine design.