1.1 INTRODUCTION:

The world's energy demand, especially in developing countries, is growing steadily. Global energy use is expected to grow by 75 percent by 2020. The development allows us to be witnesses to the technological progress. Engineers are working to make good use of their knowledge and available materials to produce efficient, cheap and reliable machines. Over the past decade, gas turbines have turned out to be one of the most interesting techniques for electric power production.

Today, the gas turbine can be used in several different modes in critical industries such as power generation, oil and gas, process plants, transport, and smaller related industries, as well. Compressor, combustor and turbine modules are linked in a group called gas turbine generator.

The last 20 years represent a large growth for gas turbine technology. This development is spear headed by the increase in compressor pressure ratio, advanced combustion techniques, improved technology for materials, the appearance of new coatings and new cooling schemes.This, with the conjunction of increase in compressor pressure ratio, has increased the gas turbine thermal efficiency from about 15% to over 45%.

As for the increase in gas turbine efficiency it dependents on two basic parameters enhanced efficiency in (a) pressure ratio, (b) cycle peak temperature ratio .The gas turbine has been successfully employed in large scale to generate the electricity, whereas gas turbine ensures better production power. Various means have been employed by many researchers to improve the power product of the turbines, particularly the gas turbine. One of the means is to use intercooler. The intercooler used to reduce the temperature at the high-pressure compressor, causing reduce consumption power on compressor and lower output temperature at high pressure.

Gas-turbines power plant with high pressure ratios can use an intercooler to cool the air between stages of compression, allowing you to burn more fuel and generate more power. Remember, the limiting factor on fuel input is the temperature of the hot gas created, because of the metallurgy of the first stage nozzle and turbine blades. With the advances in materials technology this physical limit is always climbing.

The intercooled used to increasing the overall efficiency of a gas turbine power plant is to decrease the work input to the compression process. These effects increase of the net specific work outputs. In this process the air is compressed in the first compressor (low pressure compressor) to some intermediate pressure and so it is passed across an intercooler, where it is cooled off to a lower temperature at fundamentally constant pressure. It is suitable that the lower temperature is as low as possible. The cooled air is directed to high pressure compressor, where its pressure is further raised and then it is directed to the combustion chamber and later to the expander. A multistage compression processes is also possible. The overall result is a lowering of the net specific work input required for a given pressure ratio.

1.2 HISTORY OF GAS TURBINES:

The gas turbine has experienced phenomenal progress and growth since its first successful development in the 1930's and even 1950's had simple –cycle efficiencies of about 17 percent because of the low compressor and turbine efficiencies and low turbine inlet temperatures due to metallurgical limitations of those times. Therefore, gas turbines found only limited use despite their versatility and their ability to burn a variety of fuels. The efforts to improve the cycle efficiency concentrated in three areas:

1. Increasing the turbine inlet (or firing) temperatures.
2. Increasing the efficiencies of turbo-machinery components.
3. Add modifications to the basic cycle.

The simple-cycle efficiencies of early gas turbines were practically doubled by incorporation inter-cooling, regeneration (or recuperation), and reheating. The back work ratio of a gas turbine cycle improves as a result of inter-cooling and reheating. However, this does not mean that the thermal efficiency will also improve. Inter-cooler and reheating will always decrease the thermal efficiency unless they are accompanied by regeneration. This is because inter-cooling decreases the average temperature at which heat is added, and reheating increases the average temperature at which heat is added, and reheating increases the average temperature at which heat is rejected. Therefore, in gas turbine power plants, inter-cooling and reheating are always used in conjunction with regeneration. These improvements, of course, come at the expense of increased initial and operation costs, and they cannot be justified unless the decrease in fuel costs offsets the increase in other costs. In the past, the relatively low fuel prices, the general desire in the industry to minimize installation costs, and the tremendous increase in the simple-cycle efficiency due to the first increased efficiency options to approximately 40 percent left little desire for incorporating these modifications.

With continued expected rise in demand and cost of producing electricity, these options will play an important role in the future of gas-turbine power plants. The purpose of this thesis is to explore this third option of increasing cycle efficiency via inter-cooler in the gas turbine cycle the thermal efficiency and specific work done can be increased and enhancing the performance of gas turbine.

1.3 REFINEMENTS IN GAS TURBINE CYCLE:

Gas turbines until the mid-1970 are suffered from low efficiency and poor reliability. In the past, large coal and nuclear power plants dominated the base-load electric power generation. Base load units are on line at full capacity or near full capacity almost all of the time. They are not easily nor quickly adjusted for varying large amounts of load because of their characteristics of operation. However, there has been a historic shift toward natural gas-fired turbines because of their higher efficiencies, lower capital costs, shorter installation times, better emission characteristics, the abundance of natural gas supplies, and shorter start up times. Now electric utilities are using gas turbines for base-load power production as well as for peaking, making capacity at maximum load periods and in emergency situations because they are easily brought on line or off line. The construction costs for gas-turbine power plants are roughly half that of comparable conventional fossil fuel steam power plants, which were the primary base-load power plants until the early 1980's, but peaking units are much higher in energy output costs.

Gas turbines usually operate an open cycle. Fresh air at ambient conditions is drawn into the compressor, where its temperature and pressure are raised. The high- pressure air proceeds into the combustion chamber, where the fuel is burned at constant pressure. The resulting high-temperature gases then enter the turbine, where they expand to the atmospheric pressure through a row of nozzle vanes. This expansion causes the turbine blade to spin, which then turns a shaft inside a magnetic coil. When the shaft is rotating inside the magnetic coil, electrical current is produced. The exhaust gases leaving the turbine in the open cycle are not re-circulated.

The open gas-turbine cycle can be modeled as a closed cycle by utilizing the air-standard assumptions. Here the compression and expansion process remain the same, but a constant-pressure heat-rejection process to the ambient air replaces the combustion process. The ideal cycle that the working fluid undergoes in this closed loop is the Brayton cycle, which is made up of four internally reversible processes. Using a closed cycle for the gas turbine develops the possibility of using a high pressure (and hence a high gas density) throughout the cycle, which would result in a reduced size of turbo-machinery for a given output.

The closed cycle open up possibilities of use of gases other than air having more desirable thermal properties. The monatomic gas such as helium which has the high value of specific heat can be used as working fluid. The better heat transfer characteristics of helium means that the heat –exchanger and pre-cooler can be about half that of units designed for use with air.

1.4 PROBLEM STATEMENT:

Basically, gas turbine which operates at lower turbine inlet temperatures will result in low performance and decrease efficiency. Lower efficiency of gas turbine means the lower power output is produced. To increase the performance of gas turbines there have several approaches. One of them is by using inter- cooler. Inter-cooling may look promising, but it does have one big disadvantage. The combustor needs to do more work. It also needs to provide the heat that was taken by the intercooler. By finding the optimum condition of this use inter-cooler, the efficiency of the gas turbine then can be improved and increased.

1.5 OBJECTIVES:

1. Study and analysis inter-cooling gas turbine cycle
2. Study the different effect of parametric (including different compressor Pressure ratios, different ambient temperature, air fuel ratio and turbine inlet temperature) uses MATLAB program.

1.6 SCOPE:

Study the performance of gas turbine and the effect of intercooler on efficiency and other parameter, explain the analytical and graphic.

1.7METHODOLOGY:

We choose Brayton cycle as a model with intercooler. In these study equations was formulated with take in to account the variability of specific heat of air and gas.MATLAB programmer was used to make calculations and result was simulated.