1.1 Introduction:

The air intake is that part of an aircraft structure by means of which the aircraft engine is supplied with air taken from the outside atmosphere. The air flow enters the intake and is required to reach the engine face with optimum levels of total pressure and flow uniformity. These properties are vital to the performance and stability of engine operation. Depending on the type of installation, this stream of air may pass over the aircraft body before entering the intake properly. Selection of the correct type of intake and the associated inlet geometry has important consequences to any airplane design. For that reason, intake design receives considerable attention in the design phase of an airplane. Steady operation of supersonic diffusers near critical mass flow is interrupted by a transient process known as buzz, and another interrupted known as surge.

The inlet is the one engine component that directly interfaces with the internal air flow and the flow about the aircraft. In fact, integration of the engine and the aircraft is one of the most complex problems and has a major impact on the performance of the air craft system. Many technical books, reports, articles, etc…, are available in open literature(public domain) that concentrate on only small parts of this major technical challenge.

The inlet interchanges the organized kinetic and random thermal engines of the gas in an essentially adiabatic process. The perfect (no loss) inlet would thus correspond to an isentropic process. The primary purpose of the inlet is to bring the air required by the engine from free-stream conditions to the conditions required at the entrance of the fan, compressor or plenum chamber in ramjet, with minimum total pressure loss. The fan and compressor works best with uniform flow of air at a

Mach number of about (0.5). Also, since the installed engine performance depends on the inlet's installation losses (additive drag, fore body cowl drag, by pass air, boundary-layer, etc.) the design of the inlet should minimize these losses.

1.2 Statement of problem:

Study the aircraft supersonic air inlet instability which occurs due to buzz and surge phenomenons.

1.3 proposed solution:

This project provides a method of preliminary design for a two-dimensional, external compression, two-ramp supersonic inlet to maximize total pressure recovery and match the mass flow demand of the engine. For an on-design condition, the total pressure recovery is maximized according to the optimization criterion, and the dimensions of the inlet in terms of ratios to the engine face diameter are calculated. The optimization criterion is defined such that in a system of (n-1) oblique shocks and one normal shock in two dimensions, the maximum shock pressure recovery is obtained when the shocks are of equal strength. This project also provides a method to estimate the total pressure recovery for an off-design condition for the specified inlet configuration. For an off-design condition, conservative estimation of the total pressure recovery is given so that performance of the engine at the off-design condition can be estimated. To match the mass flow demand of the engine, the second ramp angle is adjusted and the open/close schedule of a bypass door is determined.

The effects of boundary layer are not considered for the supersonic part of the inlet, However friction and expansion losses are considered for the subsonic diffuser.

1.4 Objectives:

- ❖ This project aims to study of instability in supersonic air intake due to change in the:
  - ✓ Engine operation.
  - ✓ Flight condition (Mach number).
- ❖ Specify the phenomenon (Buzz & Surge) which has been caused by above reasons.
- ❖ Control of supersonic air intake operation to prevent it from surge and buzz phenomenon (regardless that buzz does not occurs trouble dangerous).
- ❖ Appropriate information is provided from the study of supersonic flow nature.
- ❖ The information which used in this project showing performance of the inlet according to the on-design and off-design conditions by determining of total pressure losses.
- ❖ The project also adapted appropriate and simplify modes to analyze both buzz and surge phenomena which causes instability.

1.5 Methodology:

A great care has been taken for estimating the total pressure recovery, pressure losses and mass flow rate by using mathematical models in calculations to avoid buzz and surge.

A cross the buzz and surge calculations according to this project, the result obtained is exact and applicable to theoretical formula.