

## **THE 4 FORCES ACTING ON AN AIRCRAFT IN FLIGHT ARE:**

- Lift
- Weight
- Thrust
- Drag

### **LIFT**

The upward force that sustains the airplane in flight.

#### **How Lift Is Created**

#### **Newton's Three Laws of Motion:**

1. For every action there is an equal and opposite reaction
2. An object when in motion tends to remain in motion
3. An external force must be applied to alter that state of uniform motion.

#### **Bernoulli's Principle**

The total energy in any system remains constant. If one element increases, another must decrease to counter balance it.

Air flowing over the wing's upper surface accelerates as it passes through the constricted area just as it does in the venturi tube (Newton's Third Law of Motion and Bernoulli's Principles). The result is a decrease in pressure on the upper surface of the wing that results in the phenomena known as lift.

### **DOWNWASH**

Downwash is the flow of air downward towards the trailing edge of the wing. Also, the airflow passing under the wing is deflected downward by the bottom surface of the wing. The wing receives an upward force, therefore, downwash contributes to lift.

### **WEIGHT**

- The downward force due to gravity, directly opposed to lift.
- The weight of an airplane acts through the Centre of Gravity (C of G).
- It is the point through which the resultant of the weights of all the various parts of the airplane passes in every attitude it can assume.

## THRUST

- The force exerted by the engine and its propeller which pushes air backward with the object of causing a reaction, or thrust, in the forward direction.
- The effect is the same whether the thrust is produced by a propeller moving a large mass of air backward at a relatively slow speed or by a jet moving a small mass of air backward at a high speed.

## DRAG

Resistance an aircraft experience when moving forward through the air.

### Types of drag:

There are two main types of drag they are:

#### **Parasite Drag**

- Is the term given to the drag of all those parts of the airplane which do not contribute to lift (eg. the fuselage, wheels, antennas, etc.).
- *Parasite drag may be divided into two components:*
  - 1) **Form Drag** - refers to the drag created by the form or shape of a body as it resists motion through the air. Streamlining the exterior components of the aircraft helps reduce this type of drag.
  - 2) **Skin Friction** - refers to the tendency of air flowing over a body to cling to its surface; dirt, mud or ice that has accumulated on the aircraft contributes to skin friction.

#### **Induced Drag**

- Is caused by those parts of the airplane which are active in producing lift (eg. the wing). Therefore, it is always present and cannot be eliminated.

The greater the lift, the greater the induced drag. Airflow over the top of an airfoil tends to flow inward, airflow under the bottom of the wing tends to flow outwards, at the trailing edge, small eddies are created. These tend to move to the tips resulting in wing tip vortices which are the chief contributors to induced drag.