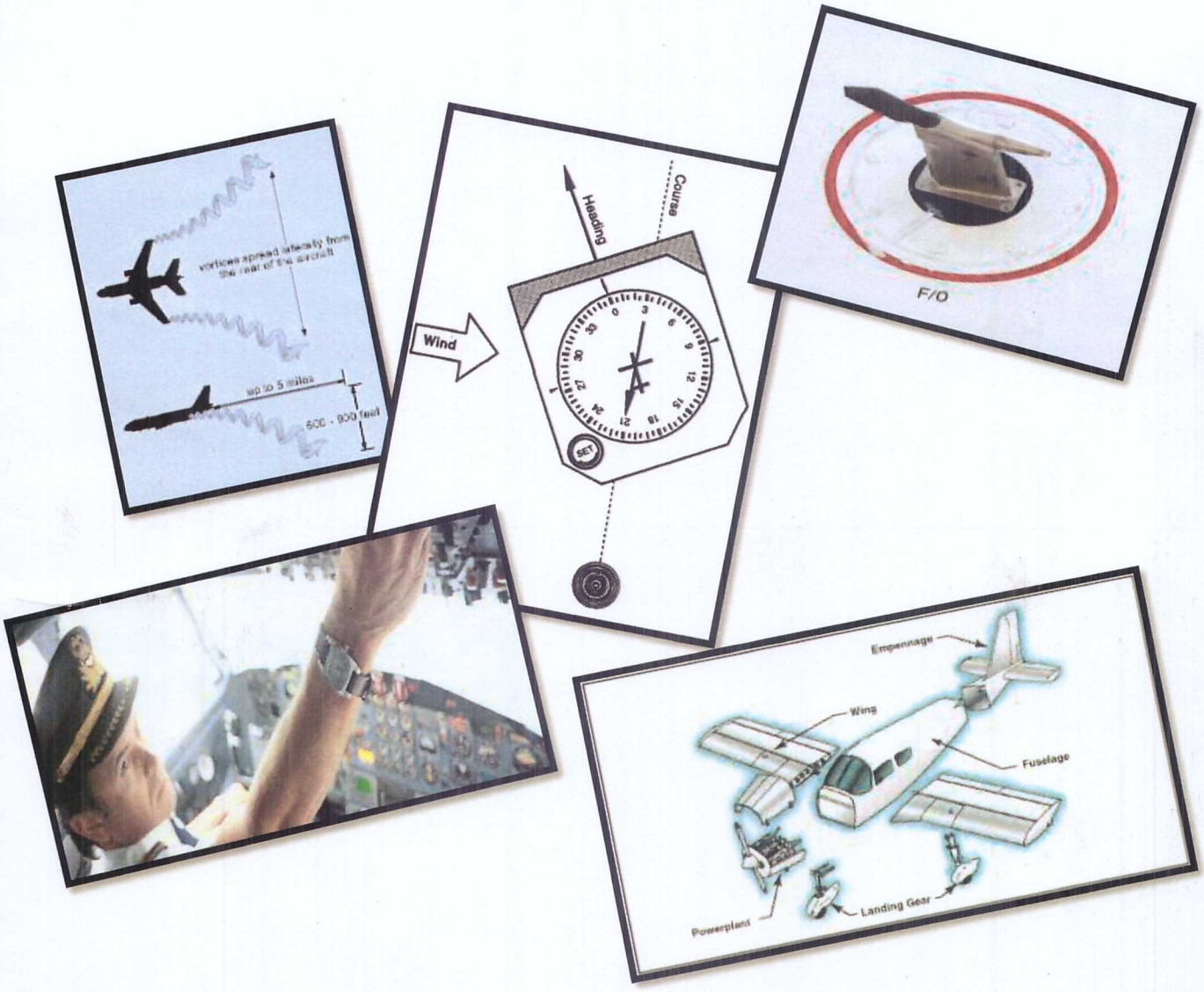
SPECIALIZED LANGUAGE FOR AVIATION (S.P)



Provided by: Ali - Dalirian

IRANBOOKLET

مرجع آزمون های شبیه سازی شده هوانوردی

WELCOME TO THE WORLD OF AVIATION

- Aviation is the design, development, production, operation, and use of aircraft, which is taken from the latin word `` avis`` which means bird .

Basically, aviation is divided into two major divisions : 1) Military 2) Civil aviation, which is managed and directed by International Civil Aviation Organization (ICAO)

International Civil Aviation Organization (I.C.A.O) -

- A specialized agency of the united nations whose objective is to develop the principles and techniques of international air navigation and the national civil air transport .

Flying an aircraft is considered both an art and a science .

- Science is the development of aviation technology, and,
- The skillful use of these technologies along with the rules and procedures by pilots shall be considered an art .

Safety of the flight –

- Safety is an accumulation of knowledge about risk applied to operation of an aircraft .
- An smart pilot should have the ability and the knowledge to analyze the changes in flight condition, to think ahead of aircraft, and, to make correct decision immediately on the nature of the changes in flight conditions .
- **In an emergency or abnormal conditions happening :**

1) Maintain aircraft control ; 2) Analyze the situation ; 3) Take proper action; and

4) Land as soon as possible .

A B C

Always **B**e **C**areful

- PILOT–IN–COMMAND (P . I . C) OF AN AIRCRAFT IS RESPONSIBLE FOR THE OPERATION OF AIRCRAFT, SECURITY AND SAFETY OF FLIGHT, CREW MEMBERS AND PASSENGERS WHILE IN COMMAND .

(Pilot-In-Command)

- Generally, each flight is considered to be either domestic or international flight .

Domestic flight -

- A flight which does not cross international borders .

International flight -

- A flight which crosses one or more international borders .

Aircraft crew members –

- An aircraft crew member includes flight crew and cabin crew .

(Aircraft Crew member)

Crew list –

- A sheet which includes the flight and cabin crew members in the order of appearance .

Flight crew member -

- A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period .

(Aircraft flight crew members at their station which is called cockpit or flight deck)

Flight crew member station -

- Flight crew are seated at a station which is called cockpit (flight deck).

NOTE- Cockpit are considered either Full-Glass Cockpit, Semi-Glass Cockpit and Analog-Type Cockpit .

Flight crew member in the order of appearance -

1) Pilot-in command (P.I.C) :

- Is the person responsible for its operation and safety during flight. This would be the captain in a typical two pilot aircraft .

2) First officer (F.O) :

- In commercial aviation, the first officer is the second pilot (co-pilot) of an aircraft. The first officer is second-in-command, and In the event of incapacitation of the captain, the first officer will assume command of the aircraft .

(The first officer is the second pilot-in-command)

Control of the aircraft between captain and first officer -

- Control of the aircraft is normally shared equally between the first officer and the captain, with one pilot normally designated the "pilot flying" (PF) and the other "pilot not flying" (PNF), or "pilot monitoring" (PM).
- During each moment of flight, only one pilot may have the direct control of the aircraft as coordinated .
- For positive transfer of controls , when a pilot (pilot flying) wishes the other pilot to take the control of the aircraft, should say :

`` YOU HAVE THE FLIGHT CONTROLS ``

- The other pilot (pilot not flying) should immediately response by saying :

`` I HAVE THE FLIGHT CONTROLS ``

- The flying pilot confirms this controls transfer by saying :

`` YOU HAVE THE FLIGHT CONTROLS ``

NOTE- There should never be any doubts as to who is flying the aircraft at any time, since, many accidents have occurred due to lack of communication or misunderstanding as to who actually had the control of the aircraft, particularly between students and flight instructor .

Pilots in the order of position :

1) Aircraft commander (A/C)
2) Instructor pilot (I.P)
3) Captain/pilot (P)
4) First officer/co-pilot (C.P)
5) Observer

Cruise relief pilot -

- A flight crew member to perform pilot duty during cruise flight, to allow the pilot-in-command or a co-pilot to obtain planned rest .

Augmented flight crew -

- A flight crew that includesmore than the minimum number required to operate the aeroplane . each flight crew member can be replaced by another active flight crew member for the purpose of in-flight rest .

NOTE - Jump-seat is a seat used by instructor pilot or observer .

Student pilot training process -

Private pilot license (P.P.L): 350 hours of ground school, 40 hours of actual flight, and, 5 hours of simulator .

Commercial pilot license (C.P.L): 330 hours of ground school, 100 hours of actual flight, and, 10 hours of simulator .

Instrument rated pilot (I.R): 40 hours of flight including 20 hours of actual flight and 20 hours of simulator .

Airline transport pilot license (A.T.P.L): To upgrade for an aircraft captain, it is require to log a flight time of 1,500 hours .

3) Flight navigator -

- A flight navigator is the person on an aircraft responsible for its navigation. The navigator's primary responsibility is to be aware of aircraft position at all times and keep the airplane on course .

4) Flight engineer (F.E) -

- Is the member of an aircraft's flight crew who monitors and operates the aircraft systems, and is responsible for ensuring that all components of the plane are in proper working order .

5) Radio operator -

- The main responsibility of the Radio Operator is to provide reliable communications between the aircraft and the air traffic controllers .

Cabin crew member -

- A crew member who performs, in the interest of safety of passengers .

- Cabin crew members (flight attendants) are either : Steward or stewardess .

NOTE - The chief of the cabin crew is called `` purser`` .

Aviation medical examiner (AME) -

- Is a physician designated by the local aviation authority and given the authority to perform flight physical examinations and issue aviation medical certificates .

Fatigue -

- A physiological state of reduced mental or physical performance capability .

- For the purpose of managing fatigue, the Operator shall establish regulations and limitations for flight time , and rest period limitations .

Passengers -

- The people who are travelling on a plane which are listed in a form called ``passengers manifest`` . Passengers stations are classified as : First class, Business class, and, Economy class .

NOTE- Upon completion of embarking, the flight attendant and pilot will annuonce to the passenger about flight information .

- Passengers are either embarking, on board or disembarking and are classified as follows : 1) Adults: Over 12 years old . 2) Child: 2 to 12 years old .
  3) Infants: Less than 2 years old .

Aircraft interior equipment :

Seat belt, Shoulder harness, Catering (Inflight service for the passengers during the whole flight), aisle, hat rack, First aid kit, Flash light, Mega phone, Crash axe, fire extinguisher,

Emergency locator transmitter (ELT) –

- An equipment which broadcast signals and, may be automatically activated by impact or be manually activated .

Flight recorders -

- Any type of recorder installed in the aircraft for the purpose of completing accident / incident investigation, which includes the following systems :
  1) Flight Data Recorder (F.D.R) 2) Cockpit Voice Recorder (C.V.R)

Smoke Hood, Supplemental Oxygen, Emergency Exit Door, Emergency Exit Hatch

Flying objects are divided into two separate classifications :

1) Aircraft:

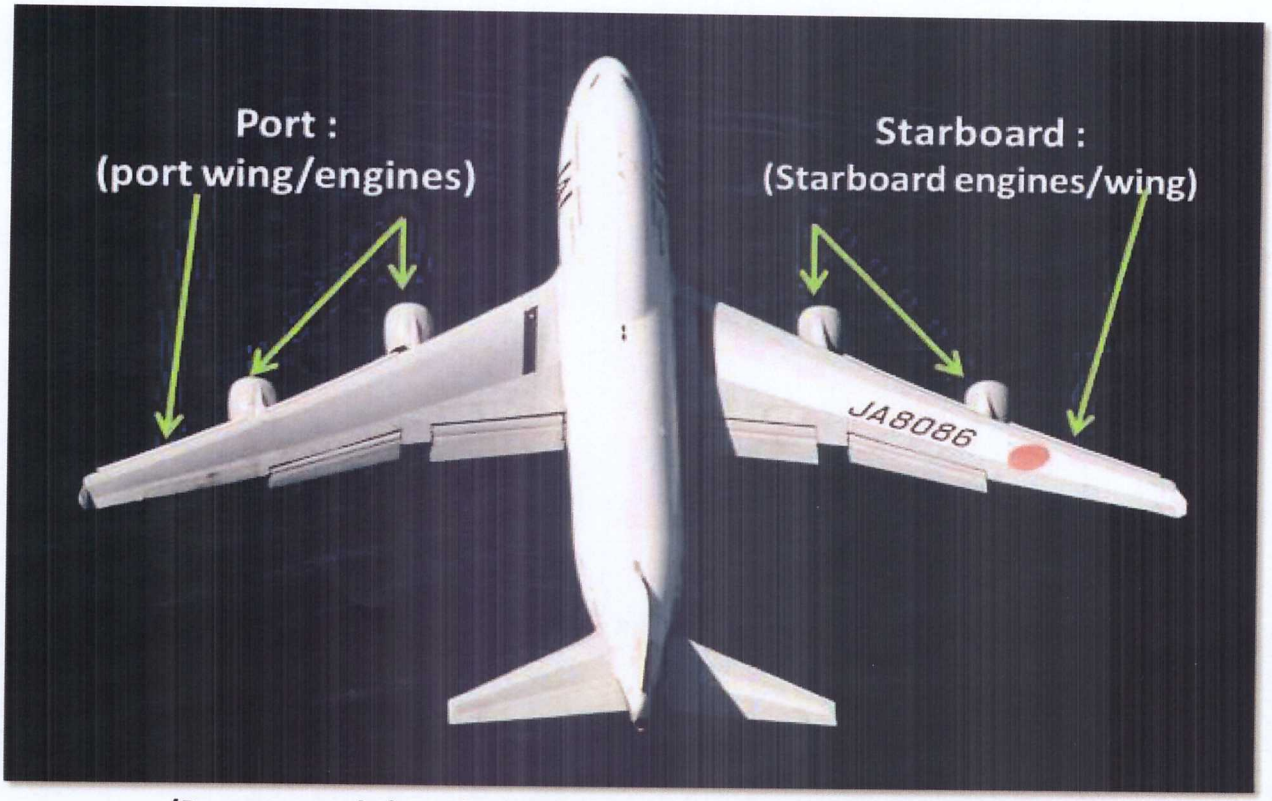
- Any machine that can derive support in the atmosphere from the reactions of the air .

2) Aeroplane –

- A power-driven heavier-than-air aircraft, deriving it`s lift in flight chiefly from aerodynamic reactions on surfaces.

Aircraft Exterior-

- Port side of aircraft is considered as ``left`` and it`s right side is considered as ``starboard``



(Port means left and starboard means the right side of aircraft)

(Wind shield and wind shield wiper)

Life Raft, Life Vest, Emergency Exit Door, Emergency Scape Rope, Emergency Evacuation,

Break–In-Point -

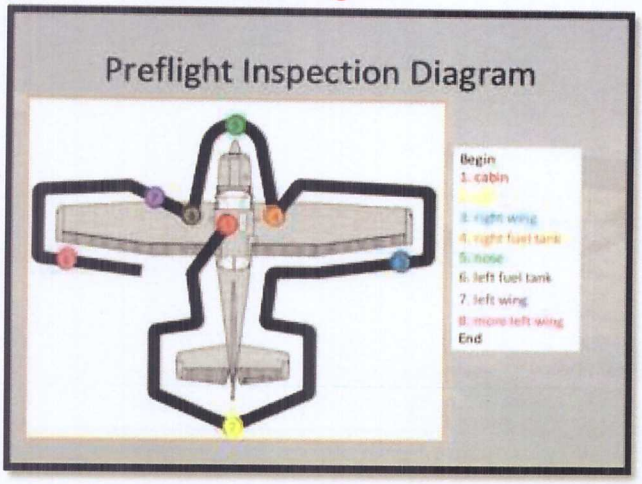
- Areas on fuselage of an aeroplane, suitable for break-in by rescue team in emergency, and, shall be marked in yellow or red color .

Radome -

- Radome, a combination of radar and dome, is an enclosure that protects radar antenna .

Pre-Flight Inspections -

- Is an aircraft inspection (interior/exterior) prior to beginning a flight .



Post-flight inspections (After a full-stop-landing) -

- The post-flight inspection is accomplished after each flight of the aircraft.

- The post-flight inspection is a check for obvious defects (hydraulic, fuel, and oil leakage or structural damage) and the installation of the necessary safety locks and pins.

Pilot`s operating handbook (P.O.H) -

- P.O.H is a document developed by the airplane`s manufacturer and contains the information related to a special type of an airpla

A typical P.O.H includes the following type of information :

1) General 2) Limitations 3) Airplane systems 4) Emergency procedures

5) Normal procedures 6) Abnormal procedures 7) Performance

8) Weight and balance 9) Servicing, handling, and maintenance

Maximum takeoff weight -

- The maximum allowable weight for takeoff .

Maximum landing weight -

- The greatest weight that an airplane normally is allowed to have at landing as specified by the manufacturer.

Emergency and abnormal procedures (Forced Landing) -

- An immediate landing, off an airport, necessitated by the inability to continue further flight, such as an engine failure .

Emergency and abnormal procedures (Ditching) -

- Ditching is a forced landing on water .

Checklist (To do list) -

- A checklist is an informational job aid used to reduce failure due to potential limits of human memory and attention. It helps to ensure completeness in carrying out a duty .

All pilots shall use a checklist as a set of instructions, carefully going through each step, one at a time before moving onto the next one .

Check-lists shall be used for the following phase of flight :

1) Pre-flight inspections ;

2) Before engine start ;

3) Engine starting ;

4) Before taxiing ;

5) Before take-off ;

6) After take-off ;

7) Cruise ;

8) Descent ;

9) Before landing ;

10) After landing, and ;

11) Engine shutdown and secur (A typical check-list sequence)

INFINITE FLIGHT CL

REV.1 H

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PRE-START

BRIEFING	CONFIRMED
BRAKES	ON
THROTTLE	IDLE
SPOILERS	CHECK (OFF)
FLAPS	RETRACTED
SEATBELTS	ON
NO SMOKING	ON
NAVIGATION LIGHTS	OFF
BEACON LIGHTS	ON
LANDING LIGHTS	OFF
STROBE LIGHTS	OFF
FLIGHT PLAN	COMPLETE
RUDDER/AILERON	TEST
CRUISE SPD+ALT	SET

AFTER START-TAXI

PSH.B/TAXI	CLEARENCE
SEATBELTS	ON
NO SMOKING	ON
NAVIGATION LIGHTS	ON
TAKEOFF FLAPS	SET
BRAKES	OFF
FORWARD THRUST	SET

PRE-TAKEOFF/HOLD SHORT

BRIEFING	CONFIRMED
LANDING LIGHTS	ON
STROBE LIGHTS	ON
TAKEOFF FLAPS	CHECK
FLT CONTROLS	CHECKED
CABIN	READY

AFTER TAKEOFF/CLIMB

GEAR	UP
FLAPS	RETRACT
A/P	ENGAGE
LANDING LIGHTS	OFF
SEATBELTS	OFF
NO SMOKING	ON

APPROACH-FINAL

BRIEFING	CONFIRMED
SEATBELTS	ON
NO SMOKING	ON
LANDING LIGHTS	ON
APPR	SET (IF APPLICABLE)
FLAPS	FULL
GEAR	DOWN/LOCK
SPOILERS	ARMED
BRAKES	SET
TRIM	SET
CABIN	READY
MINIMUMS	CHECK

AFTER LANDING/TAXI

SPOILERS	OFF
FLAPS	RETRACT
LANDING LIGHTS	OFF
STROBE LIGHTS	OFF
A/P/APPR	DISENGAGED

CONTACT GROUND

PARKING

BRAKES	ON
THROTTLE/S	IDLE
SEATBELTS	OFF
NO SMOKING	ON

SHUTDOWN

BRAKES	ON
THROTTLE	IDLE
FLAPS	RETRACTED
SPOILERS	OFF
LANDING LIGHTS	OFF
STROBE LIGHTS	OFF
NAVIGATION LIGHTS	OFF
A/P PREFS	CLEAR
TRIM	NONE
FLIGHT PLAN	CLEAR
BEACON LIGHTS	OFF

Phonetic alphabet and presentation in aviation –

A = Alfa / B = Bravo / C = Charlie / D = Delta / E = Echo / F = Foxtrot / G = Golf
H = Hotel / I = India / J = Juliette / K = Kilo / L = Lima / M = Mike / N = November
O = Oscar / P = Papa / Q = Quebec / R = Romeo / S = Sierra / T = Tango
U = Uniform / V = Victor / W = Whisky / X = X-ray / Y = Yankee / Z = Zulu

Examples : T.B.Z = Tango, Bravo, Zulu / V.R = Victor, Romeo
P.I.M = Papa, India, Mike / Z.A.J = Zulu, Alpha, Juliette

Aeroplane -

- A power-driven heavier-than-air aircraft, getting its lift in flight chiefly from aerodynamic reactions on surfaces .

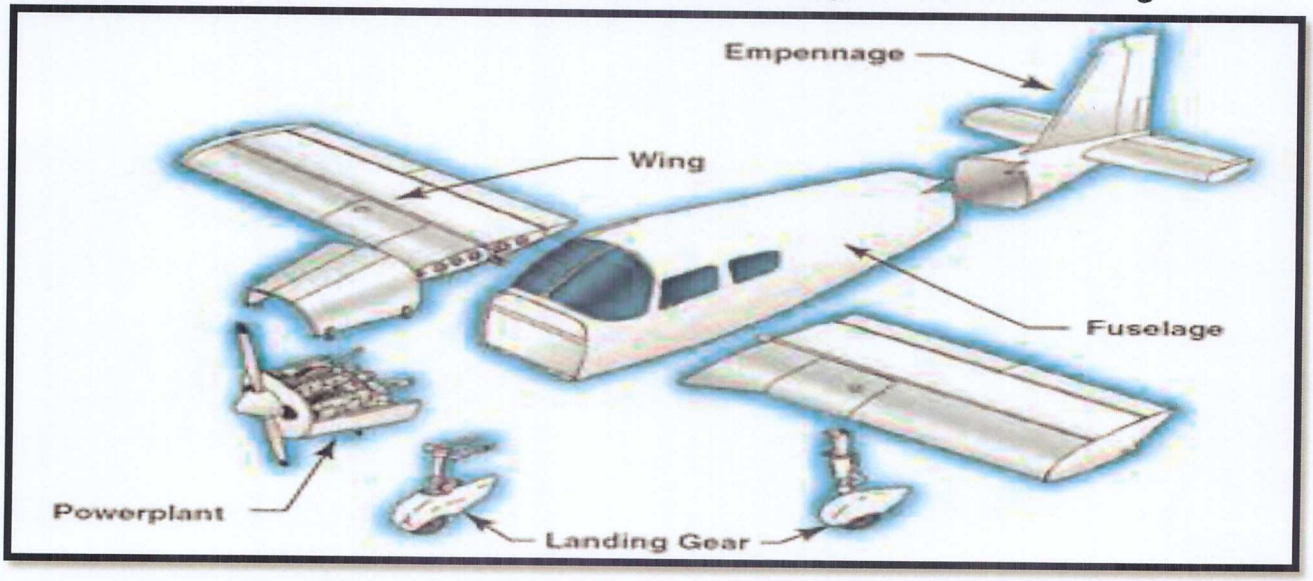
Aerodynamics -

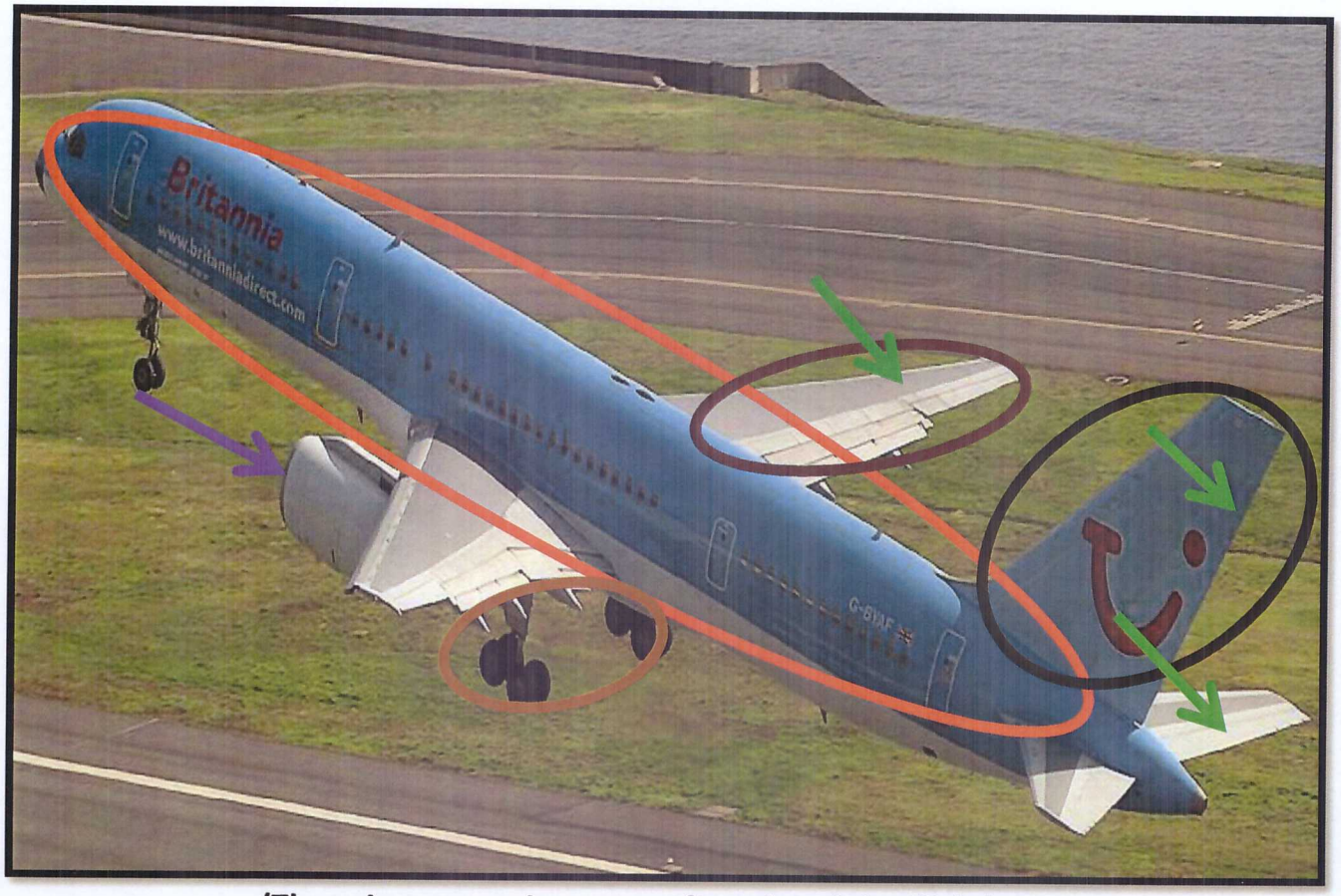
- The science of the action of the air on other object, and with the motion of air on other surfaces and bodies .

Overview to the principles of flight -

The primary requirements of an aircraft for flight are as follows :

1) A fuselage to house the payload ;
2) A wing to generate a lift force ;
3) Tail surfaces (empennage) to add stability ;
4) Control surfaces to change the direction of flight;
5) Power plant (engine) to make it go forward, and ;
6) Landing gear to support it`s weight when parked, taxiing, take off and landing





(The primary requirements of an aircraft for flight)

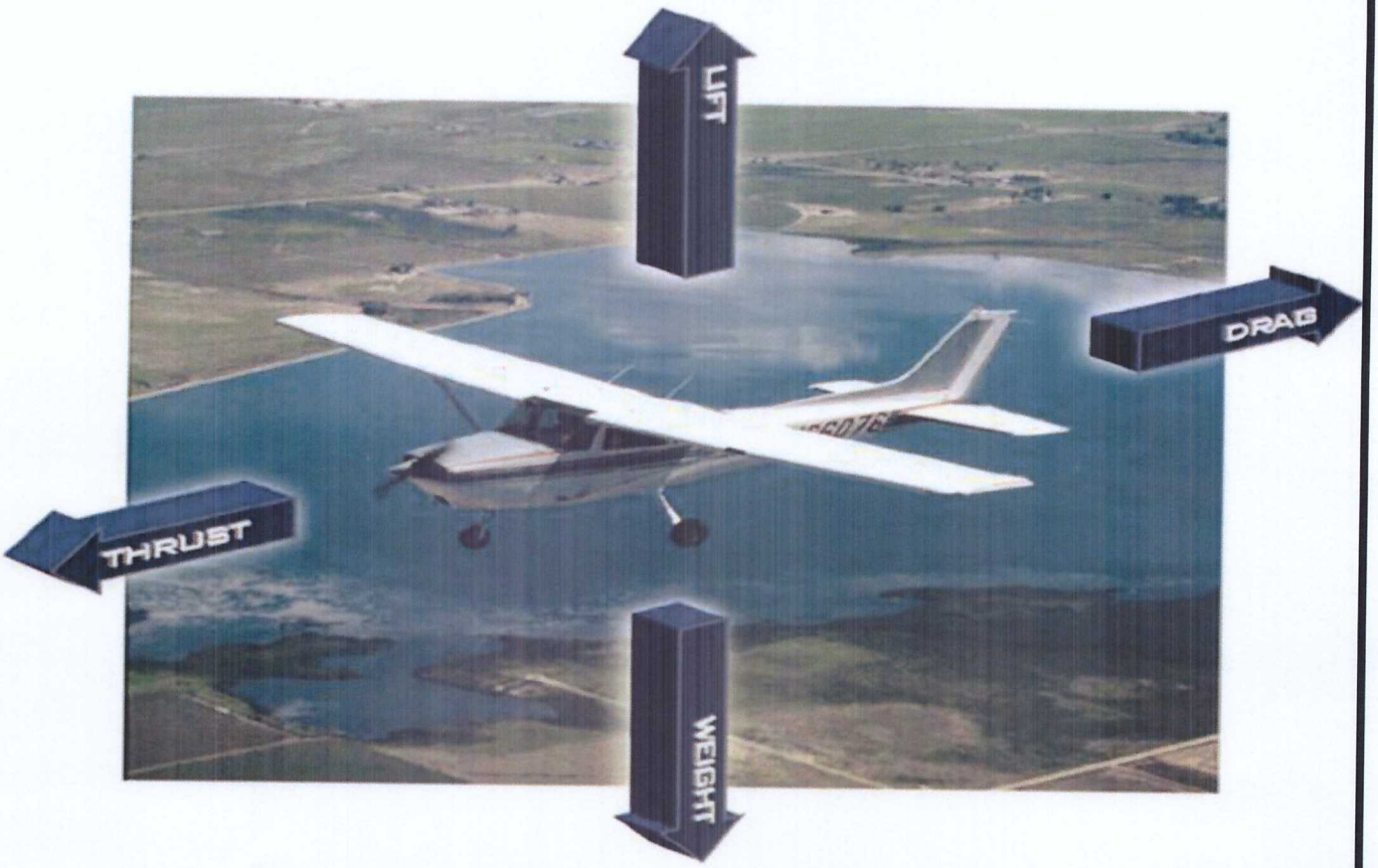
NOTE-Specific principles of aerodynamics for an aircraft apply to climbs, descents, and turning maneuvers .

Fuselage -

- The fuselage is the central body of an airplane and is designed to accommodate the crew, passengers, and cargo .
- It also provides the structural connection for the wings, tail empennage, landing gear and power plant .

During flight, there are four aerodynamic forces acting on the airplane .

These forces are : 1) Lift 2) Weigh 3) Thrust 4) Drag



(Lift)

``Lift is the key of aerodynamic forces``

It is the upward force that opposes the weight and is created by the effect of airflow as it passes over and under the wing and supports the airplane in flight .

Airfoil –

- An airfoil is any surface, which provides aerodynamic force when it interacts with a moving stream of air (such as a wing) .

Wing -

- Wings are airfoils attached to each side of fuselage and are the main lifting surfaces that support the airplane in flight .

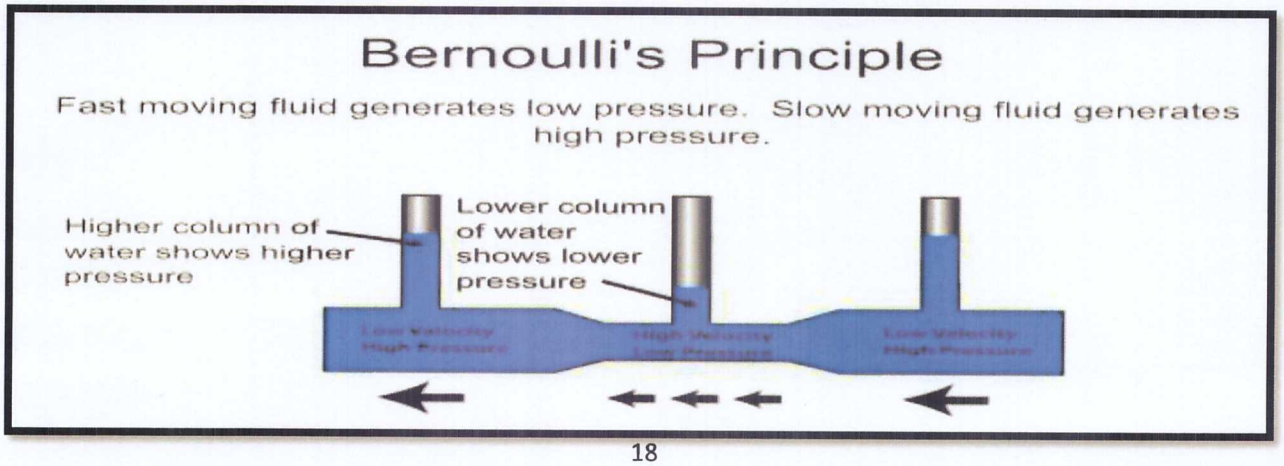
- when the air flows around the wings of an airplane, it generates a force called `` lift`` due to differential pressure which in turn create lift force to help the airplane to fly .

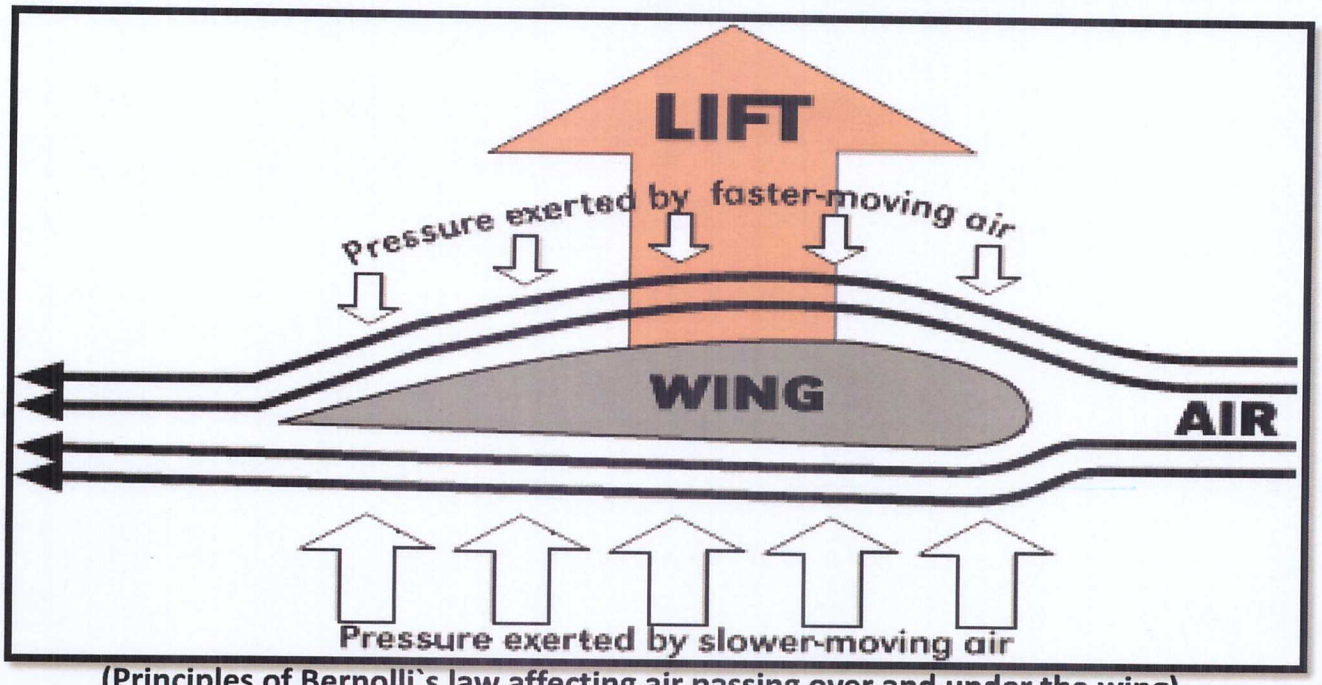
(The most typical form of an airfoil is a wing which is used in the aircraft)

Bernoulli`s principles (A Swiss physicist) – ``Venture tube``

- The basic principles of differential pressure of airflow was discovered by Daniel Bernoulli . the Bernoulli`s law simply says that :

`` AS VELOCITY OF AIR DECREASES, ITS PRESSURE INCREASES ``





(Principles of Bernolli`s law affecting air passing over and under the wing)

Leading edge -

- The leading edge is the part of the wing that first contacts the air;and is the foremost edge of a wing section .

Trailing edge -

- That is the portion of the wing where the airflow over the upper surface rejoins lower surface airflow .

Wing root -

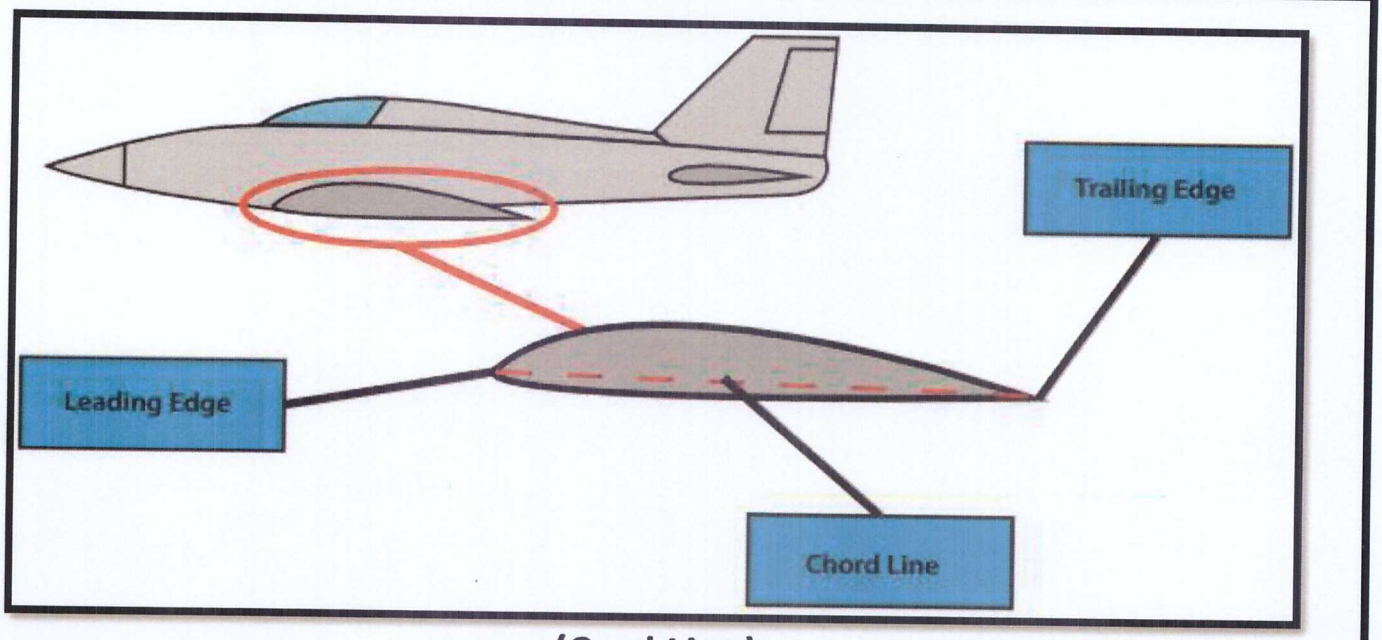
- Is that part of the wing on an aircraft that is closest and connected to the fuselage .

Wing-tip (the opposite end of the wing-root) –

- Is the part of the wing that is most distant from the fuselage of an aircraft .

chord line -

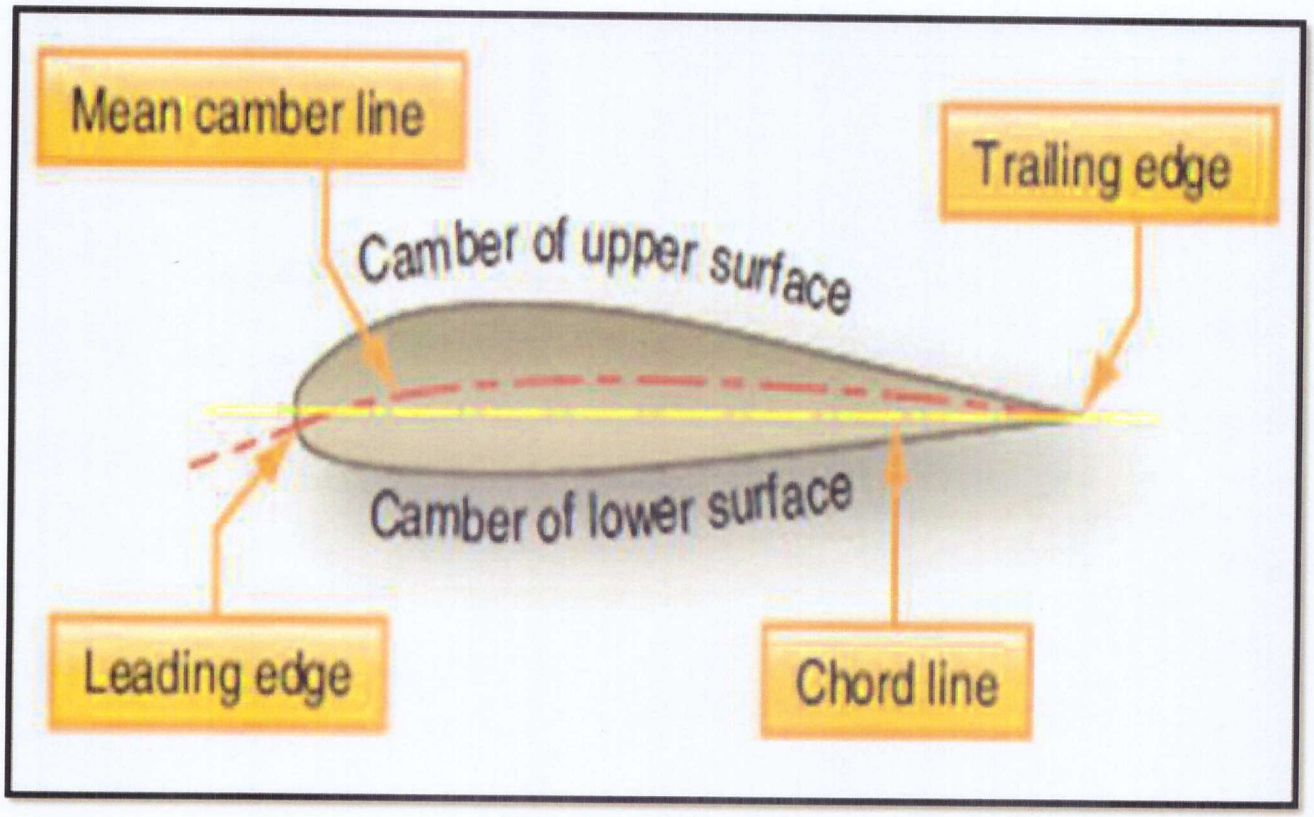
- The chord line is an imaginary straight line drawn through the wing from the leading edge to the trailing edge .



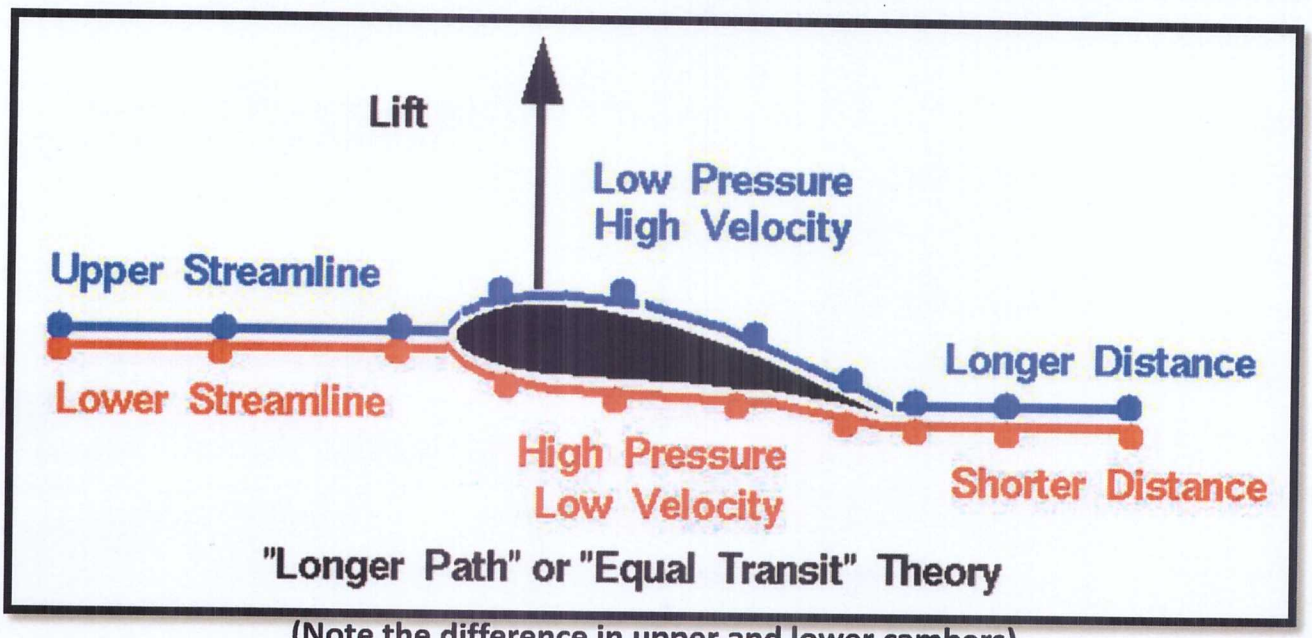
(Cord Line)

Camber –

- The camber of a wing is the curve of its upper and lower surfaces from the leading edge to the trailing edge .



(Cambers of a wing)



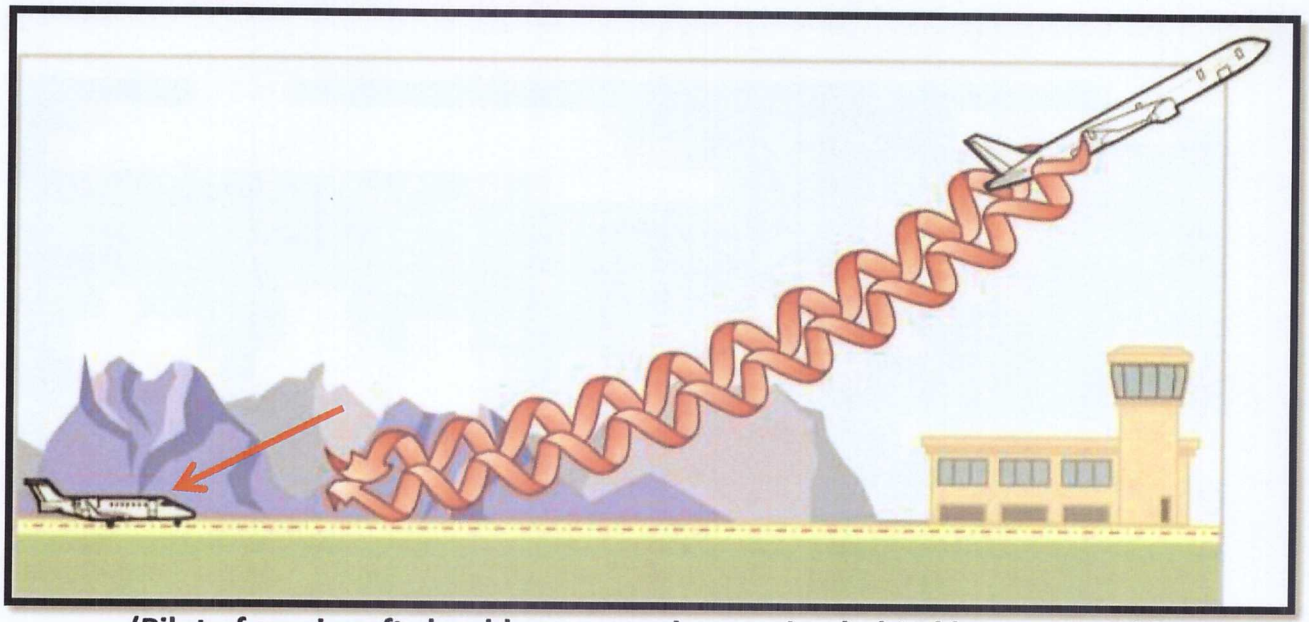
(Note the difference in upper and lower cambers)

- The difference over the shapes of cambers causes the velocity of airflow immediately above thewing to be much higher than that below the wing, causing differential pressure, due to Bernoulli`s principle :

  (lower pressure above and higher pressure below the wing)
- This differential pressure creates an upward force which is the main source for lift and supports the airplane in flight .

Wingtip vortices -

- Are circular patterns of rotating air left behind a wing as it generates lift, which may create dangers for the aircraft behind .



(Pilot of an aircraft should use excessive caution behind heavy aircraft)

Wing let -

- To improve the efficiency of an aircraft , winglets are designed to reduce the intensity of wingtip vortices, which trail behind the plane and pose a hazard to other aircraft .

(Winglet also reduces drag besides vortices)

Wingspan -

- The wingspan of an airplane is the maximum distance from one wingtip to the other wingtip .

Wing area -

- The wing area is the area which is one of the chief factors affecting airplane lift , and it is almost half of the total surface area .

- Wings may be attached at the top, middle, or lower portion of the fuselage, and, these designs are referred to as high wing – mid wing and low wing respectively .

High-wing aircraft -

- A wing that helps lift an aircraft, When positioned above the fuselage .

Mid-wing aircraft –

- A wing that helps lift an aircraft, When positioned in the middle of the fuselage .

Low-wing aircraft –

- Are the aircraft with the wings mounted at the bottom or below the fuselage .

Mono-plane aircraft -

- A monoplane is a fixed-wing aircraft with a single main wing .

Bi-plane aircraft -

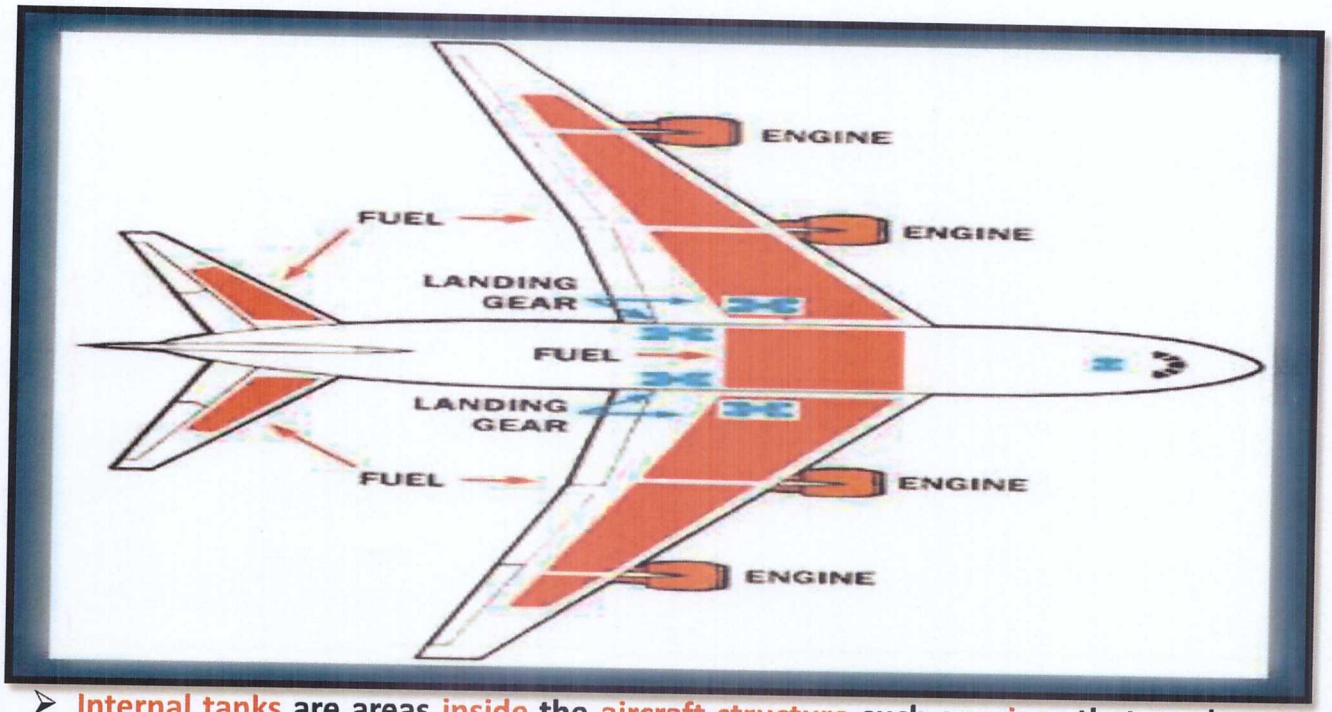
- A biplane aircraft is a fixed-wing aircraft with two main wings stacked one above the other .

Types of wing designs –

- The wing designs are classified as : Straight wing/ Elliptical wing/ Tapered wing/ Sweptback wing/ Delta wing

(various types of wings are designed for various purposes)

- Aircraft fuel tanks are a major component of aircraft fuel systems and They can be classified into internal or external tanks .



- Internal tanks are areas inside the aircraft structure such as wings that are known as fuel storage .

(External fuel tanks mounted under wings and fuselage of C-130 and F-4 aircraft)

Definition of an aircraft flight path -

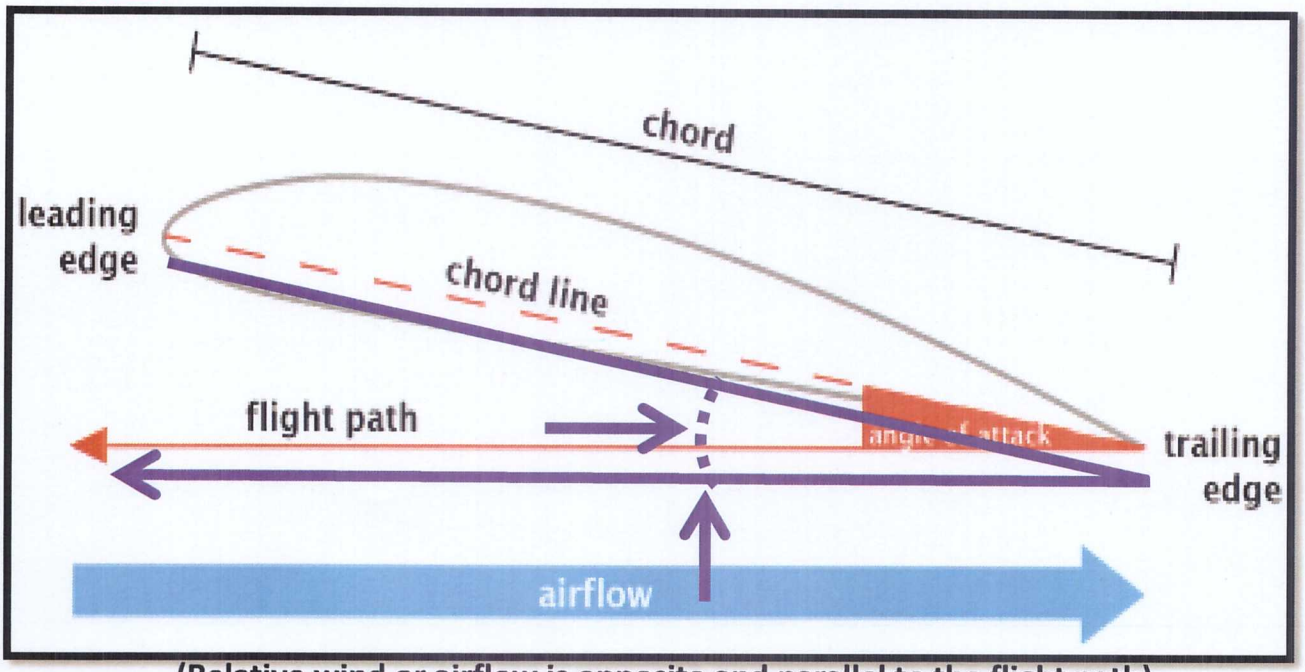
- The route or direction that an airplane travels through the air .

Relative wind -

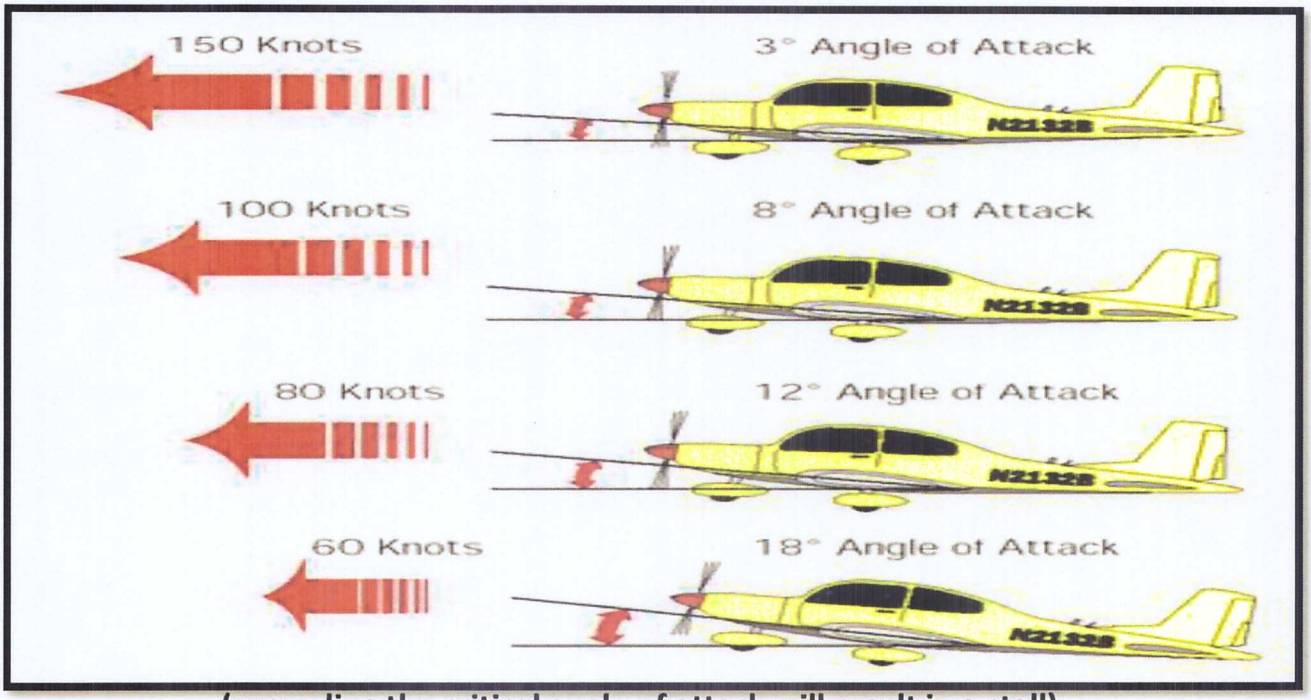
- The relative wind is the direction of movement of the atmosphere relative to an aircraft or a wing .
- It is opposite and parallel to the direction of movement of the aircraft wing .

Angle-of-attack –

- The angle between the chord line of a wing and the relative wind is defined as angle of attack .



(Relative wind or airflow is opposite and parallel to the flight path)



(exceeding the critical angle of attack will result in a stall)

- The angle of attack is of great importance to pilots because exceeding that, will reach to critical angle of attack and then result in a stall .

Critical angle of attack –

- Critical angle of attack is the angle of attack (around 16 degrees) at which a wing stalls regardless of airspeed, flight attitude, or weight .

- As the angle of attack is increased, the airspeed will decrease and at some given angle of attack the wing will stall .

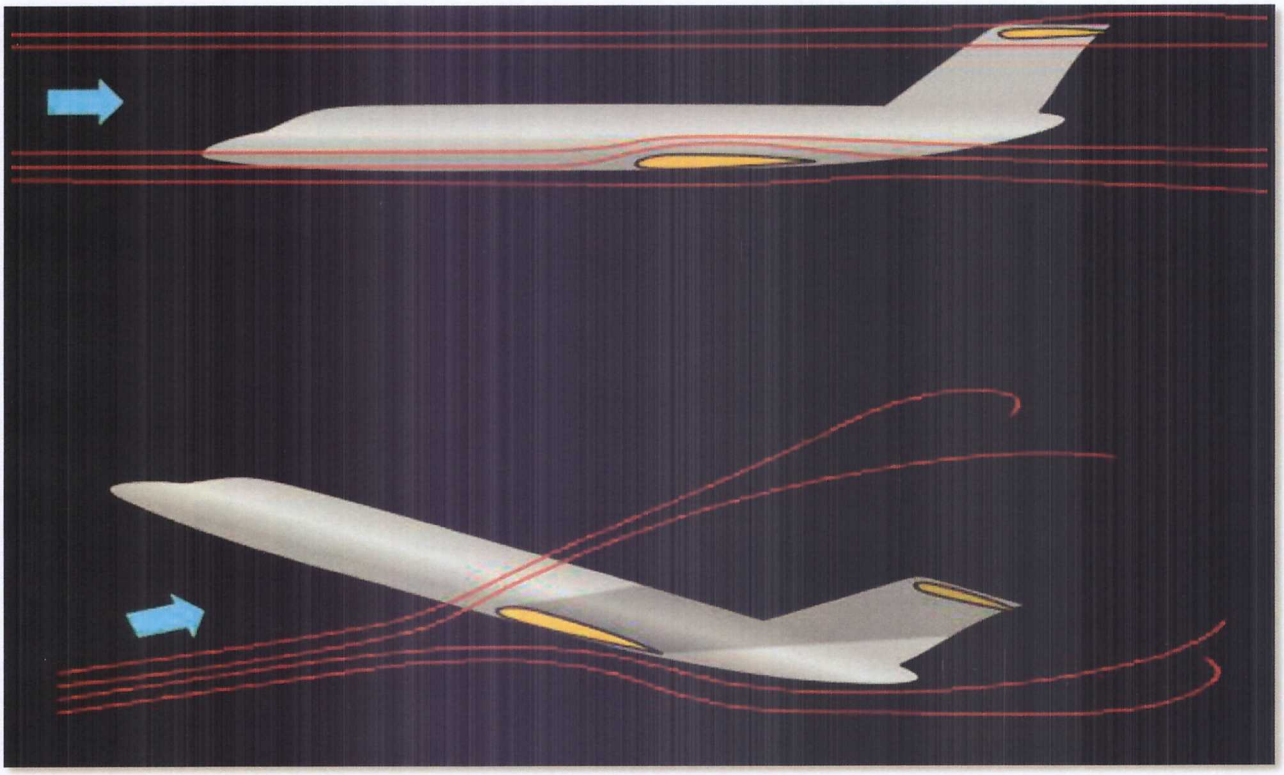
Stall –

- The stall is rapid decrease in lift caused by the separation of airflow from the wing`s upper surfaces which is occurred when the wing exceeds its critical angle of attack .

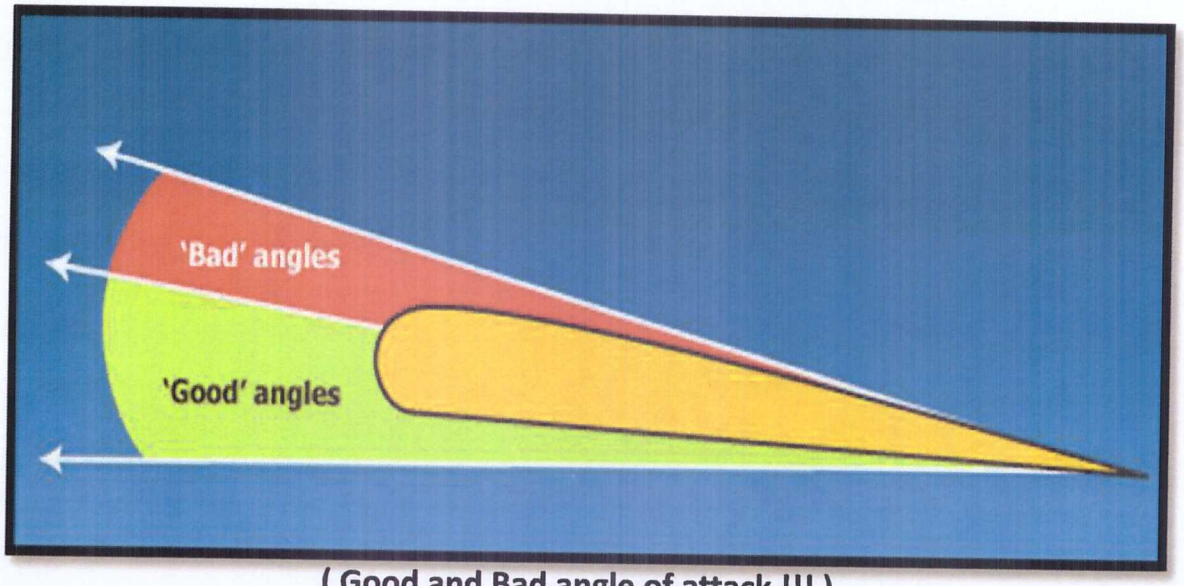
- Power-on stall and power-off stall are the most common stalls, simulated in pilot training program .

Stall speed -

- The minimum speed below which further control of flight is impossible is called the `` stalling speed``.

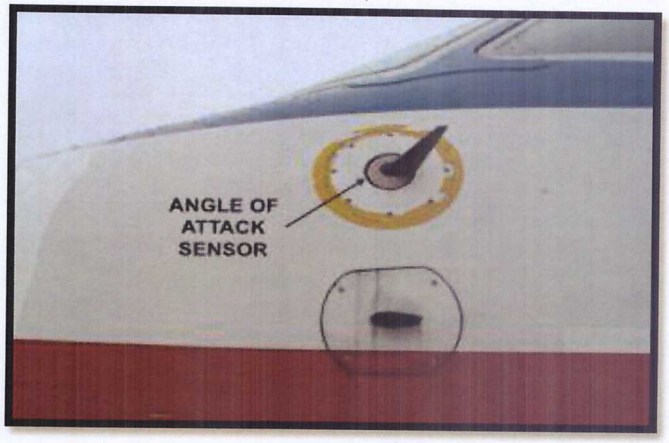


(A stall is what happens when a wing can not make enough lift to keep the aircraft in level flight. Stalling is risky and can be dangerous during low-level flying .)



(Good and Bad angle of attack !!!)

- Angle of attack sensors are usually mounted on the aircraft fuselage where the air flow disturbance is minimum and transmits a signal to the cockpit indicator .



(Angle of attack sensor and indicator)

Recognition of stalls –

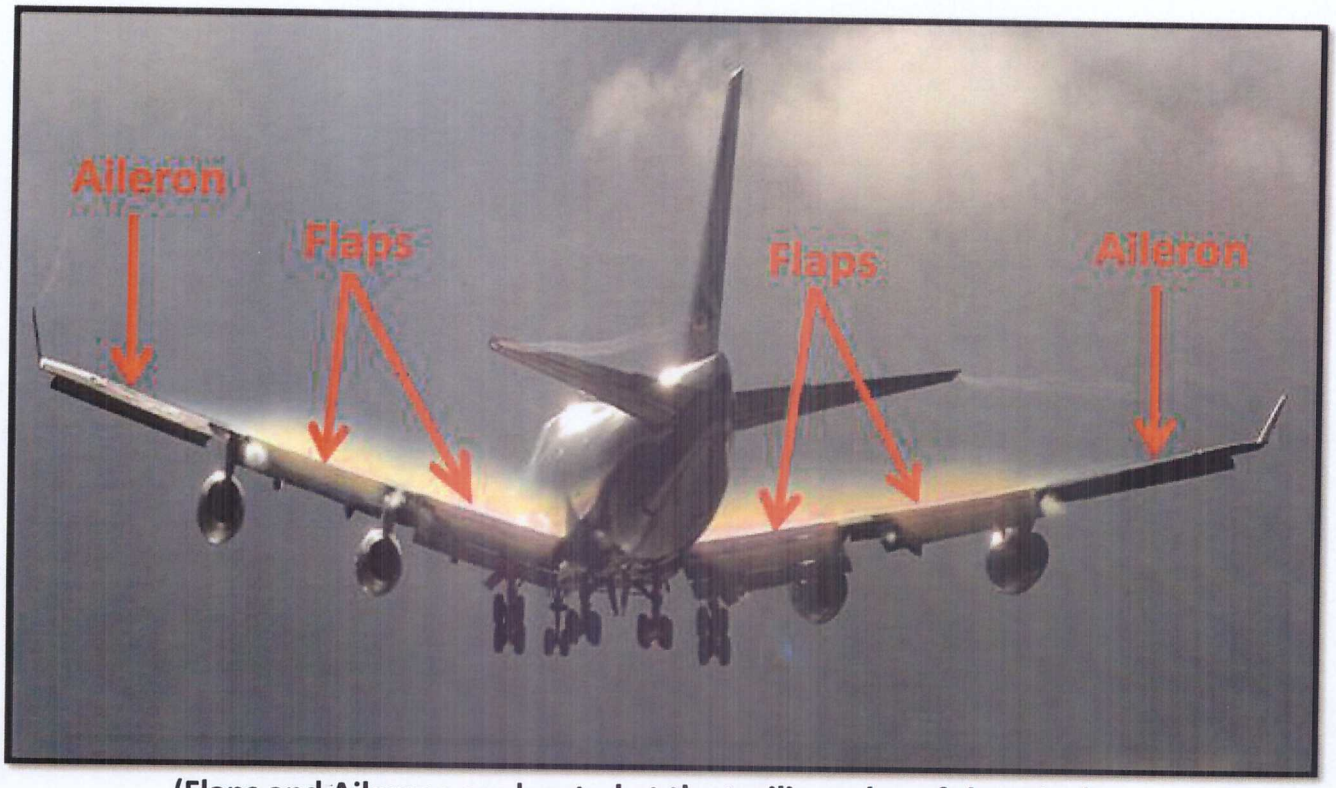
- The pilot should recognize an approaching the stall by :

1) Vision (by noting the attitude of airplane) ;
2) Sound (changed in propeller sound due to loose of R.P.
3) Feelings (controls can be moved with almost no resistance) ;
4) Buffeting, uncontrollable pitching and vibrations ;
5) Stall warning indicators which provides pilot with advanced warning of an stall .

Spin –

- A spin is defined as an aggravated stall that results auto rotation, and the airplane descends in a helical, or corkscrew path, while the angle of attack is greater than the critical angle of attack, so, a stall must occur before a spin can develop .

- The principle structural parts of the wing are two types of control surfaces attached to the rear (trailing edge) referred to as ailerons and flaps which help the pilot to fly the airplane .



(Flaps and Ailerons are located at the trailing edge of the wing)

Flaps -

- Are aerodynamic surfaces extend outward from the fuselage to near the midpoint of each wing .

Ailerons –

- The primary control surfaces, ailerons, extend from about the midpoint of each wing outward toward the tips and move in opposite directions to create aerodynamic forces that cause the airplane to roll / bank to desired heading .

- The flaps are normally retracted with the wing's surface during cruising flight .

- When flaps are extended , they move simultaneously downward to increase the lifting force of the wing for takeoffs and landings .

- The pilot can operate the flaps using a switch or handle in the cockpit .

Functions and use of flaps –

- Flaps work primarily by changing the camber of the wing and adds aft camber of the wing, therefore ;

A) Increase the lifting efficiency of the wing ;

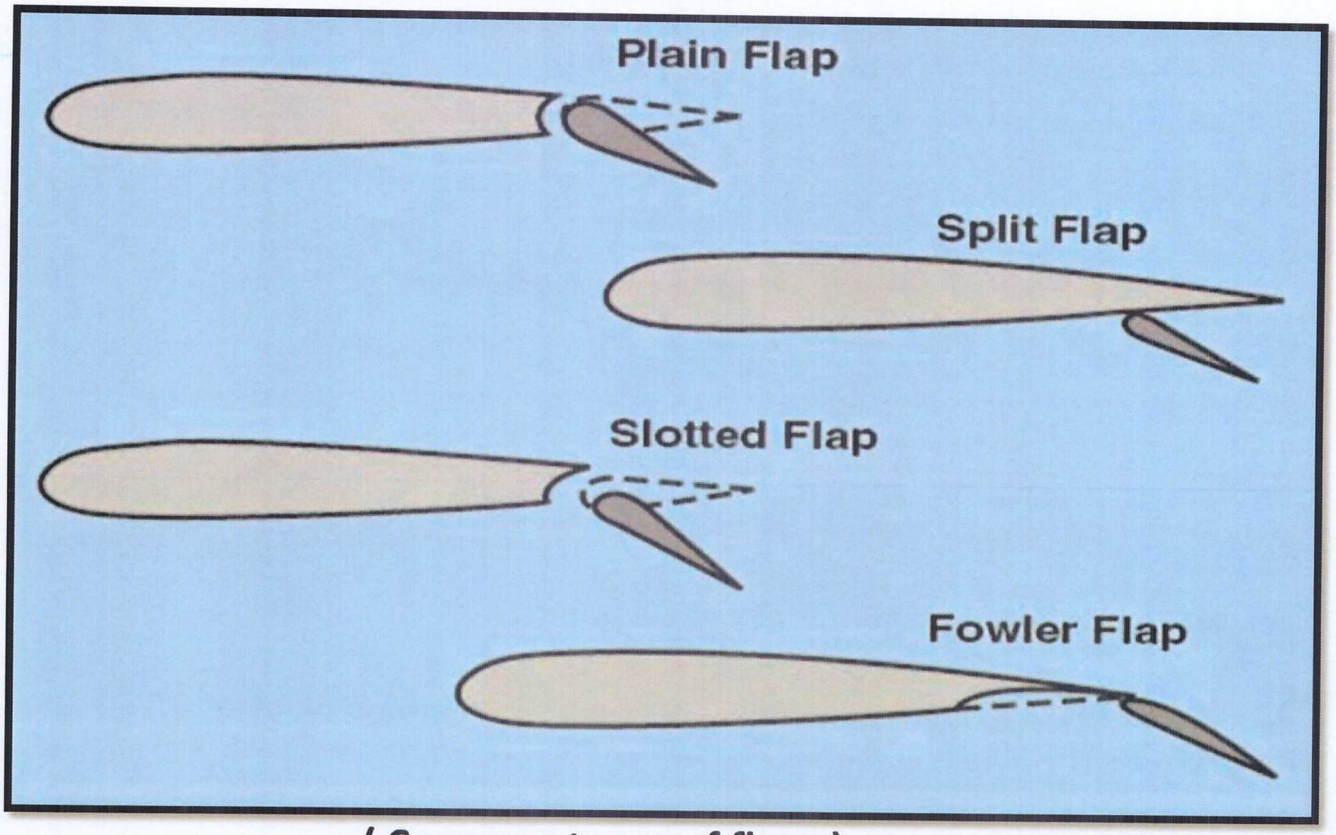
B) Decreases stall speed ;

C) To fly at reduced and slow speed when landing ;

D) Touchdown at a slower airspeed;

Common types of flaps –

- Flap effectiveness mostly depends on the size and types and are classified as follows : Plain flap/ split flap/ slotted flap/ fowler flap



(Common types of flaps)

Slat –

- A movable auxiliary airfoil on the leading edge of a wing used for take-off and landing to increase the lift, and drag of the wing .

Spoilers –

- High-drag devices that can be raised to the air flowing over an airfoil, reducing lift and increasing drag to descend without gaining speed, and also are used to shorten the ground landing roll .

Speed brakes/ Air brakes –

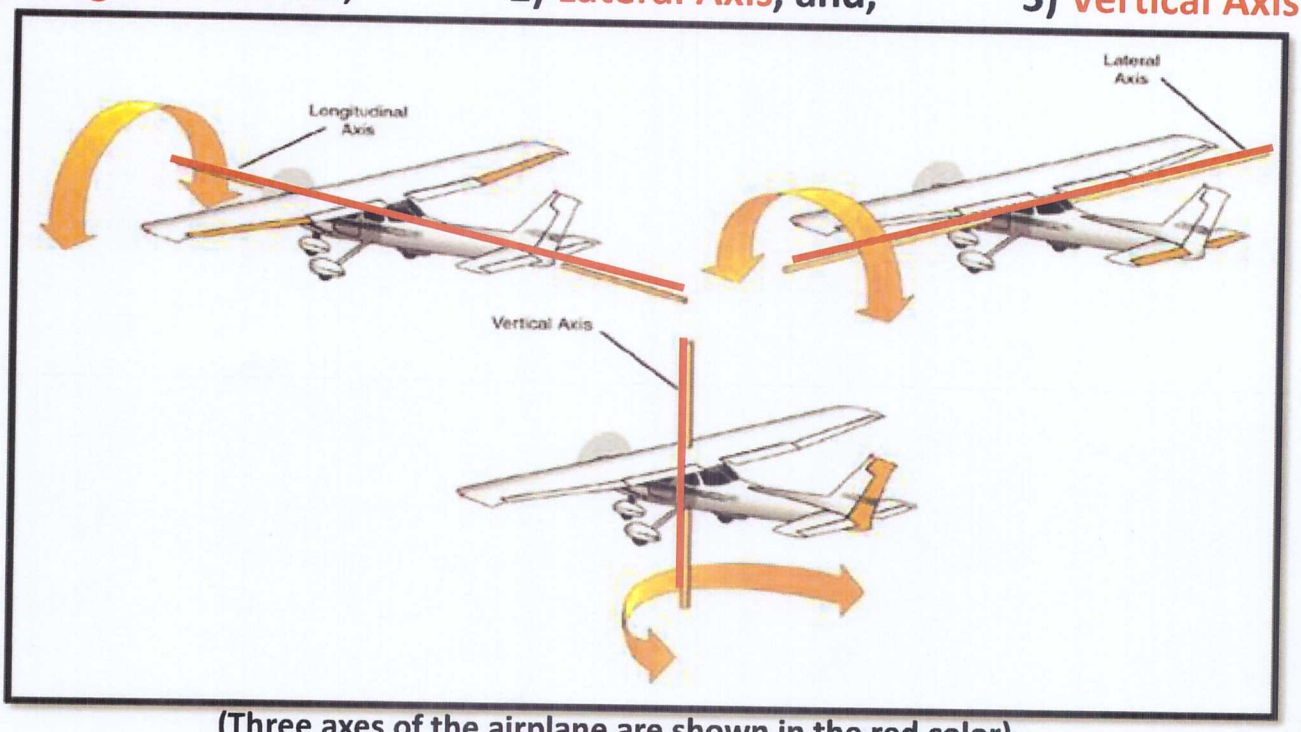
- A control system that extends from the airplane structure into the airstream to produce drag and slow the airplane

Basic Flight Maneuver

Axes of an airplane –

- There are three imaginary lines called axes that all maneuvering of an airplane takes places around one or more of these axes .They are :

1) Longitudinal Axis, 2) Lateral Axis, and, 3) Vertical Axis



(Three axes of the airplane are shown in the red color)

In addition, an airplane has also three axes of rotation:

1) Roll or bank (turn) around the longitudinal axis –

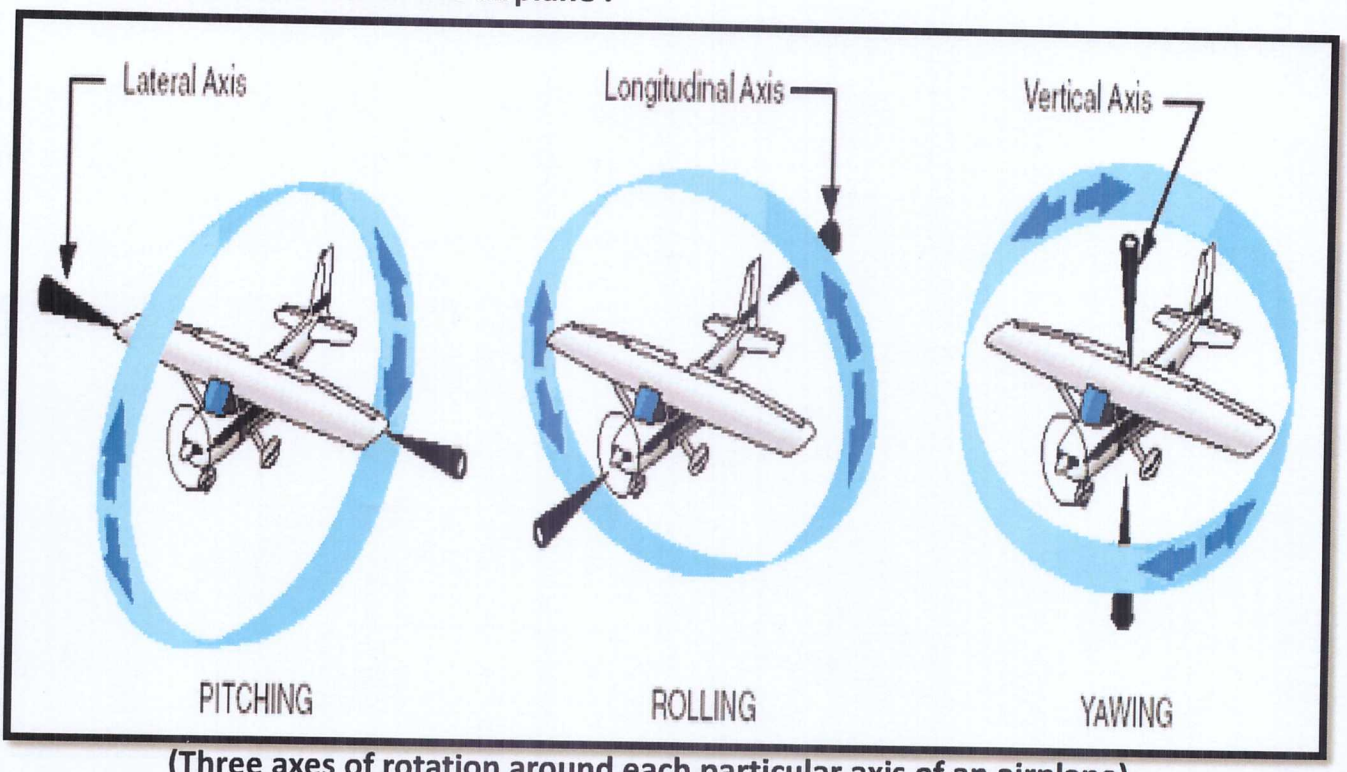
- In which one wing of the airplane moves up and the other moves down. This is typically controlled by ailerons on the wings of the airplane.

2) Yaw around the vertical axis –

- In which the nose of the airplane moves left or right. This is typically controlled by the rudder at the rear of the airplane .

3) Pitch (climb or descent) around the lateral axis–

- In which the nose of the airplane moves up or down. This is typically controlled by the elevator at the rear of the airplane .



(Three axes of rotation around each particular axis of an airplane)

Basic flight maneuvers –

- There are four fundamental basic flight maneuvers upon which all flying tasks are based on. These are called : ``FOUR FUNAMENTALS``

1) Straight-and-level flight ; 2) Turn ; 3) Climb ; and 4) Descent

The ailerons, elevator, and rudder create aerodynamic forces which cause the airplane to maneuver and rotates around the three axes .

Attitude –

- Attitude is the position of an aircraft by the relationship of its axes and the earth`s horizon .

Earth Horizon –

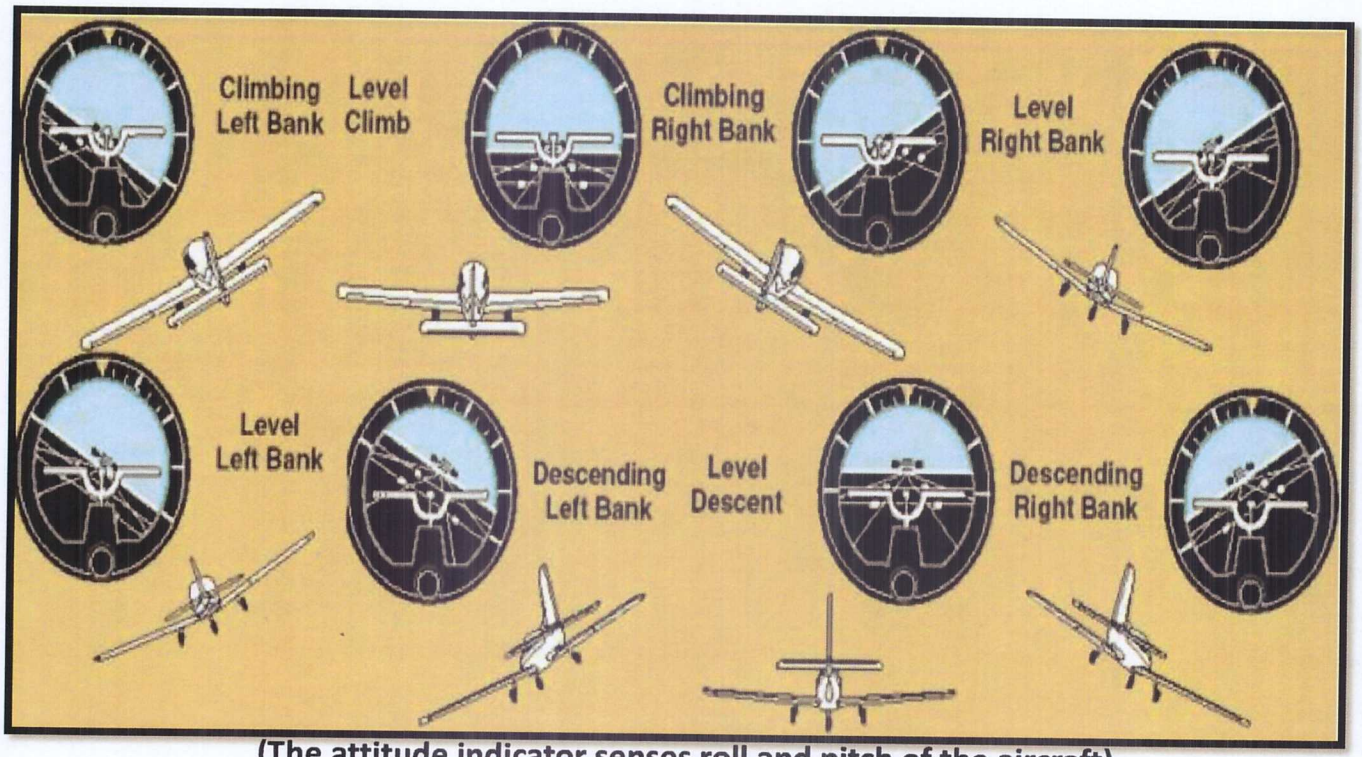
- The line of sight boundary between the earth and the sky .

Attitude indicator –

- An instrument which uses an artificial horizon and a miniature airplane to depict the position of the airplane in relation to the true (earth) horizon .

- The attitude indicator senses roll as well as pitch, which is the up and down movement of the airplane`s nose .

(Attitude, Earth Horizon, and, Attitude Indicator)



(The attitude indicator senses roll and pitch of the aircraft)

Straight-and-level flight –

- Is a flight in which a constant heading and altitude are maintained (No Roll / No Pitch).

1) Longitudinal axis or roll/turn axis, is the axis which extends from nose to tail .

Roll / Turn –

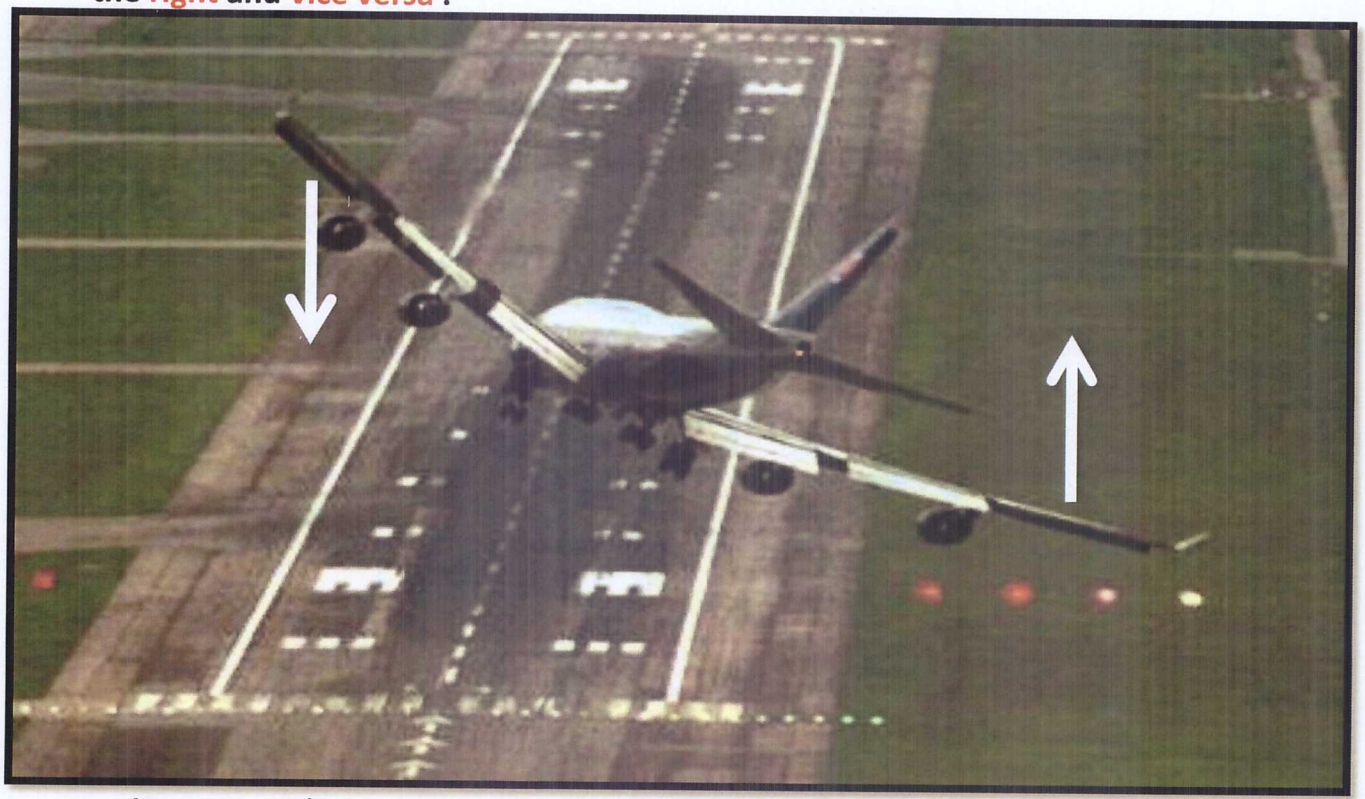
- The motion of the airplane about the longitudinal axes, which is produced and controlled by ailerons is called roll or turn .

Ailerons –

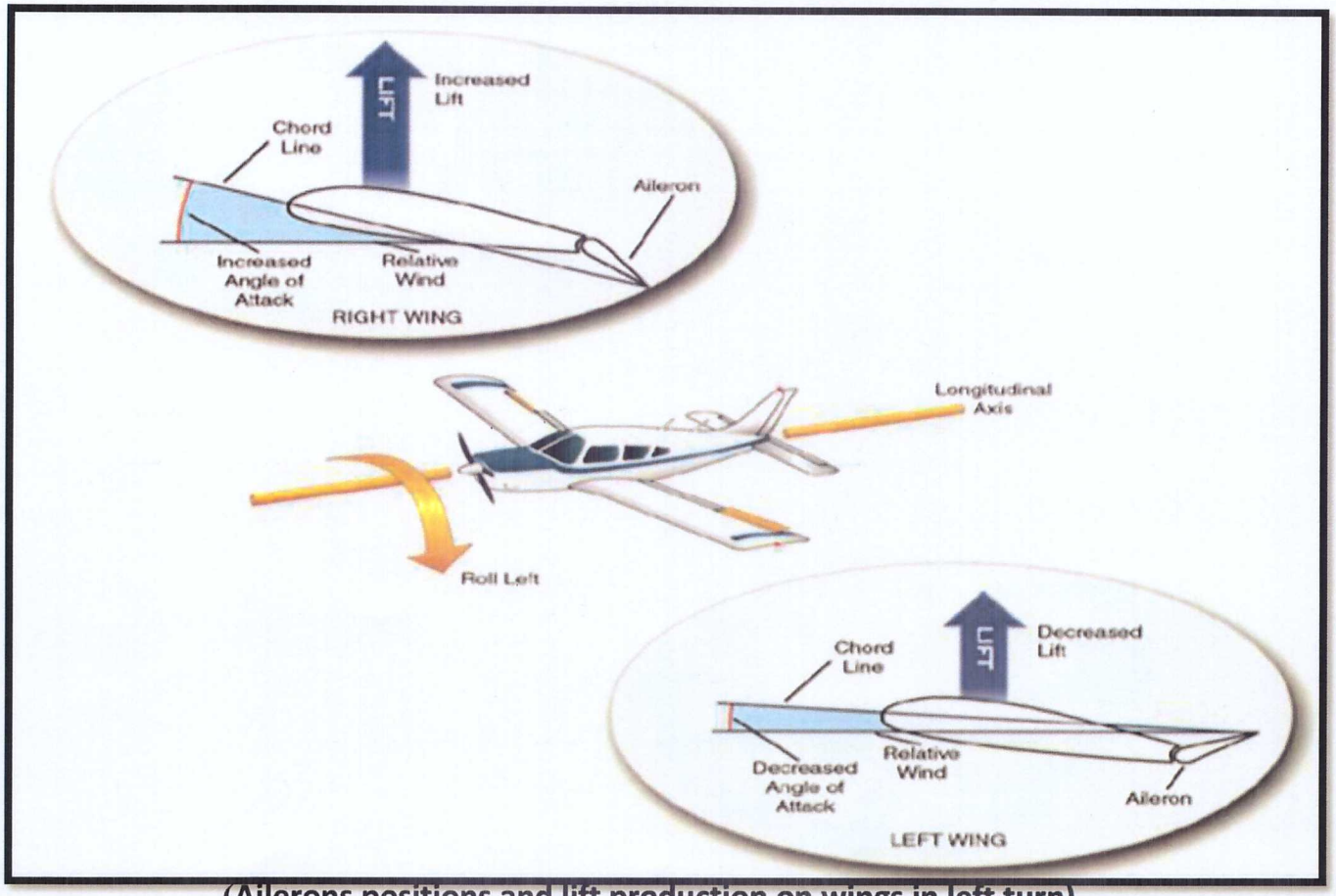
- As mentioned before, the primary control surfaces, ailerons, extend from about the midpoint of each wing outward toward the tips and move in opposite directions to create aerodynamic forces that cause the airplane to roll / bank to desired heading .

- Pilot can turn the airplane by moving the ailerons with turning the yoke in the cockpit .

- When pilot turn the yoke to the right, the right aileron moves up and the left aileron moves down which produces greater lift on the left wing causing the airplane banks to the right and vice versa .



(Right bank/Turn: Yoke to the right, right aileron up, left aileron down)



(Ailerons positions and lift production on wings in left turn)

- **The rolling movement about the longitudinal axis will continue as long as the ailerons are deflected .**

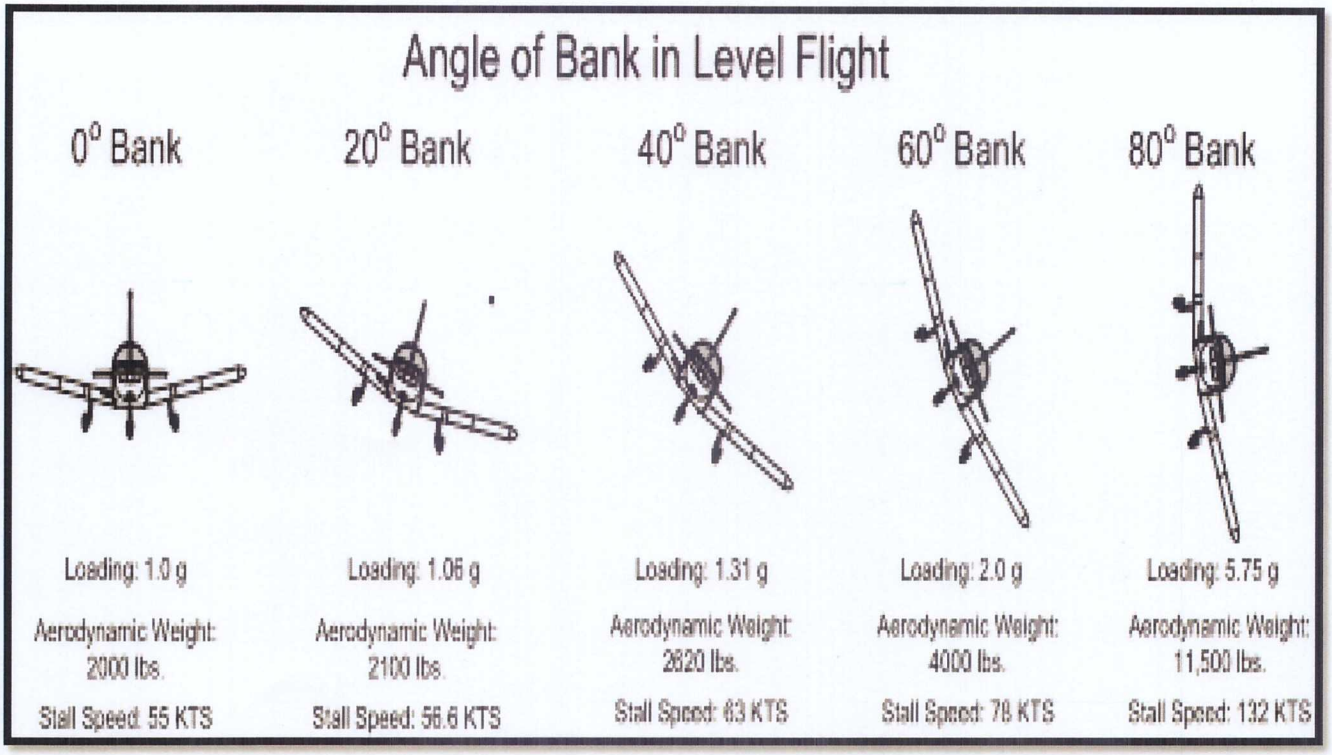
- **To stop the roll, the pilot must relax control pressure and return the ailerons to their original, or neutral position which is called ``neutralizing the controls .**

- **The roll-out from a turn is similar to the roll-in, except the flight controls are applied in the opposite direction, and must be started before reaching the desired heading, normally one-half the degrees of bank . for example, if the bank is 30 degrees, lead the roll out by 15 degrees .**

NOTE - All four primary controls (aileron, elevator, throttle and rudder) are used in close coordination when making turns .

Bank angle –

- Is the angle at which the aircraft is turning about its longitudinal axis with respect to the horizon .



Turns / bank angle classification –

Turns are divided into three classes :

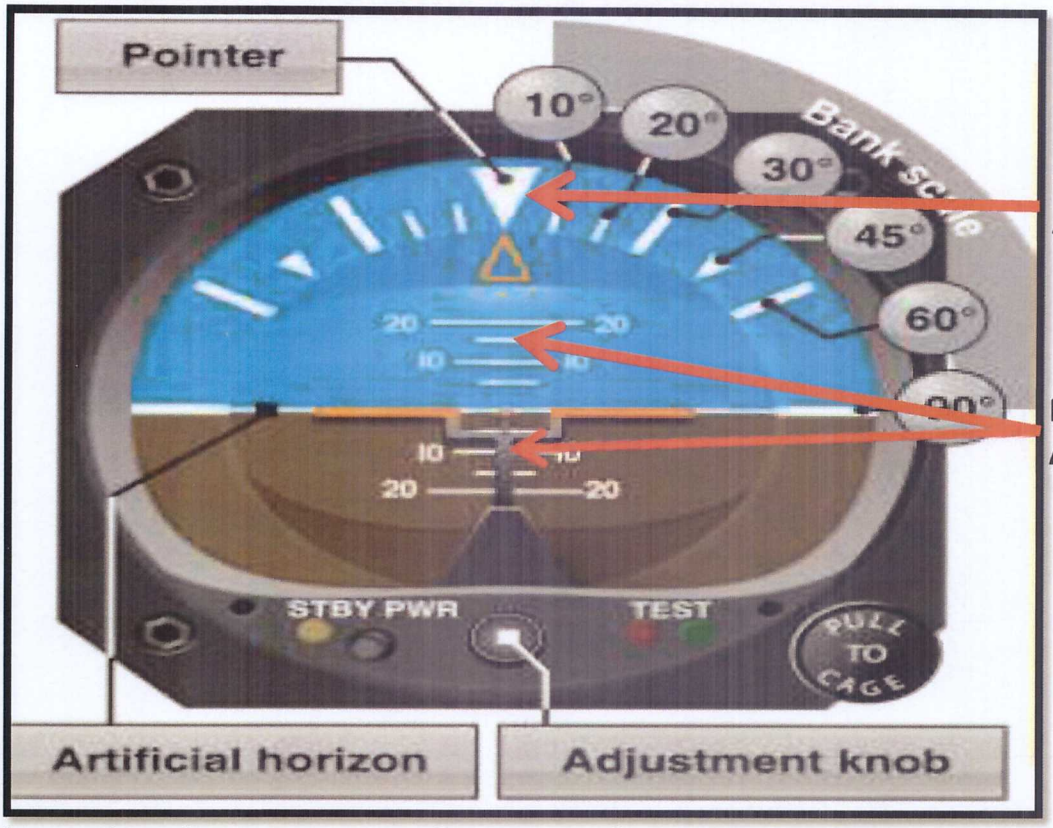
1) Shallow turns : Banks angle of less than 20 degrees ;

2) Medium turns : banks angle of between 20 to 45 degrees ; and

3) Steep turns: Banks angle of 45 degrees or more

Attitude Indicator (A.I) –

- An attitude indicator (AI), is an instrument used to inform the pilot of the orientation and position of the aircraft relative to Earth's horizon .



(Attitude Indicator senses and measures the pitch and roll of the aircraft)

- It indicates pitch and bank and is a primary instrument for flight at night and cloudy conditions .
- Bank information are indicated at the top and pitch with the aircraft image relative to the background in blue and brown .
- This instrument is located at the top center of the basic six flight instrument .

Rate of turn –

- The rate in degrees change per second of a turn .

Standard- rate- turn (two minutes turn) –

- The standard rate turn means the turning rate is three degrees per second . at this rate the pilot will complete a 360 degrees turn in two minutes .

Half-Standard- rate- turn (four minutes) –

- At this rate, the pilot will complete a 360 degrees turn in four minutes .

Radius of turn –

- Is the radius of a circle that aircraft flies around it .

Coordinated turn –

- An ideal condition of the aircraft during the turn where the tail of the aircraft follows the same path of the nose .

Skid –

- A condition where the tail of the airplane follows a path outside the path of the nose during a turn .

Slip –

- A condition where the tail of the airplane follows a path inside the path of nose during a turn .

- In proper coordinated flights, there is no skidding or slipping and the ball in the turn-and-slip indicator will center, and, displayed off- center whenever the airplane is skidding or slipping sideways .

- To maintain coordinated flight (ball centered), if the ball is not centered, the pilot usually apply enough rudder pressure on the side where the ball is deflected, the simple rule is, ``step on the ball`` .

Turn-and-slip indicator –

- Turn-and- slip indicator is flight instrument composed of a turn needle to indicate rate of turn in degrees per second, and, an inclinometer to indicate coordinated flight and turns .

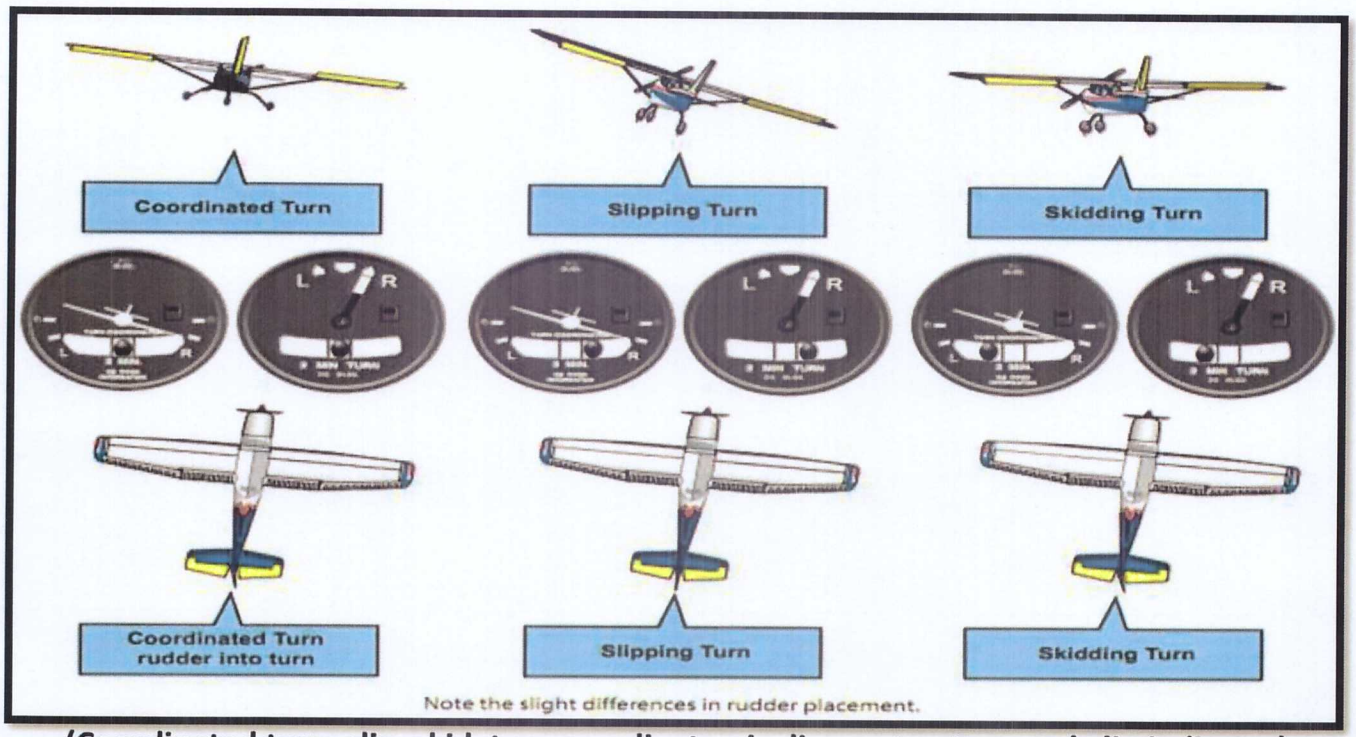
Turn coordinator –

- The turn coordinator has largely replaced the turn-and-slip indicator in modern airplanes .

- A turn coordinator consists of two parts, first, is a miniature aircraft, viewed from behind, along with tick marks designating both straight flight and a standard-rate turn , second, is a ball installed within a tube, to indicate a coordinated turn .

Inclinometer –

- The inclinometer is an important part of the turn coordinator, consisting of a liquid-filled curved tube with ball inside .
- The ball is actually a balance indicator, which is used to determine the coordinated use of aileron and rudder .



(Coordinated turn, slip, skid, turn coordinator, inclinometer, turn-and-slip indicator)

Heading indicator –

- An instrument which senses airplane movement and displays heading based on 360 degrees azimuth, with the final zero omitted .

2) Vertical axes, which is the axes that passes vertically through the center of gravity .

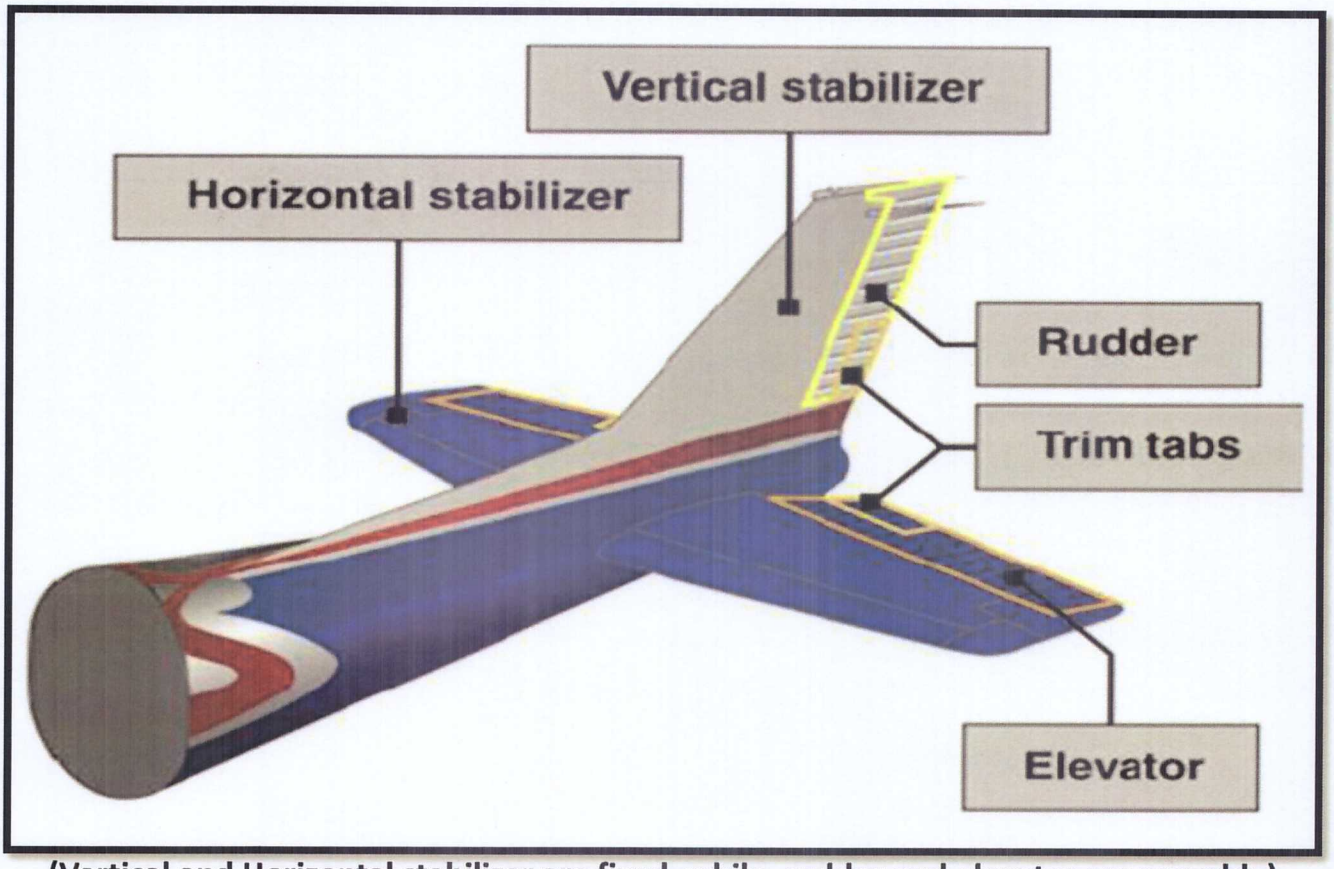
Yaw –

- The rotation of an airplane about the vertical axis, which is controlled by rudder .

Tail section (Empennage) –

- Empennage is the tail section of the airplane that consist of the vertical stabilizer, the horizontal stabilizer, and the associated control surfaces such as rudder, elevator and trim tabs .

- Horizontal and vertical stabilizer, are two surfaces that are fixed and stationary and act like the feather on an arrow and help the pilot to maintain a straight and stable path through the air .

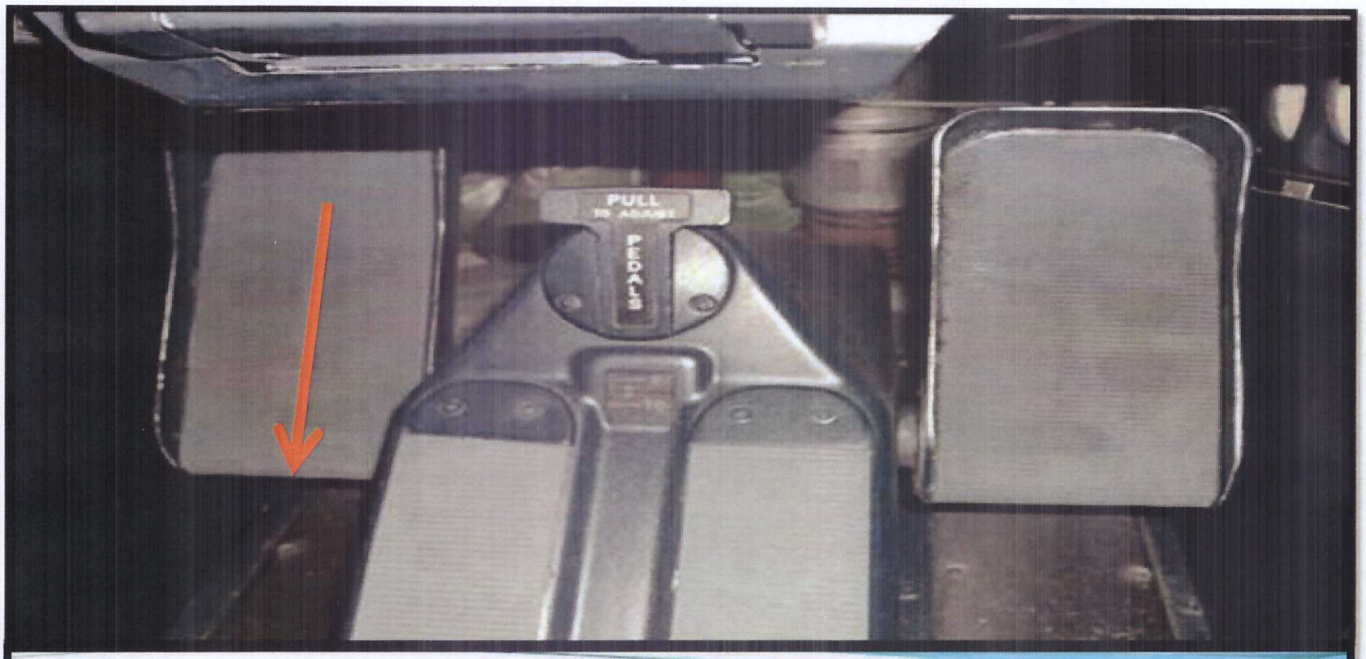


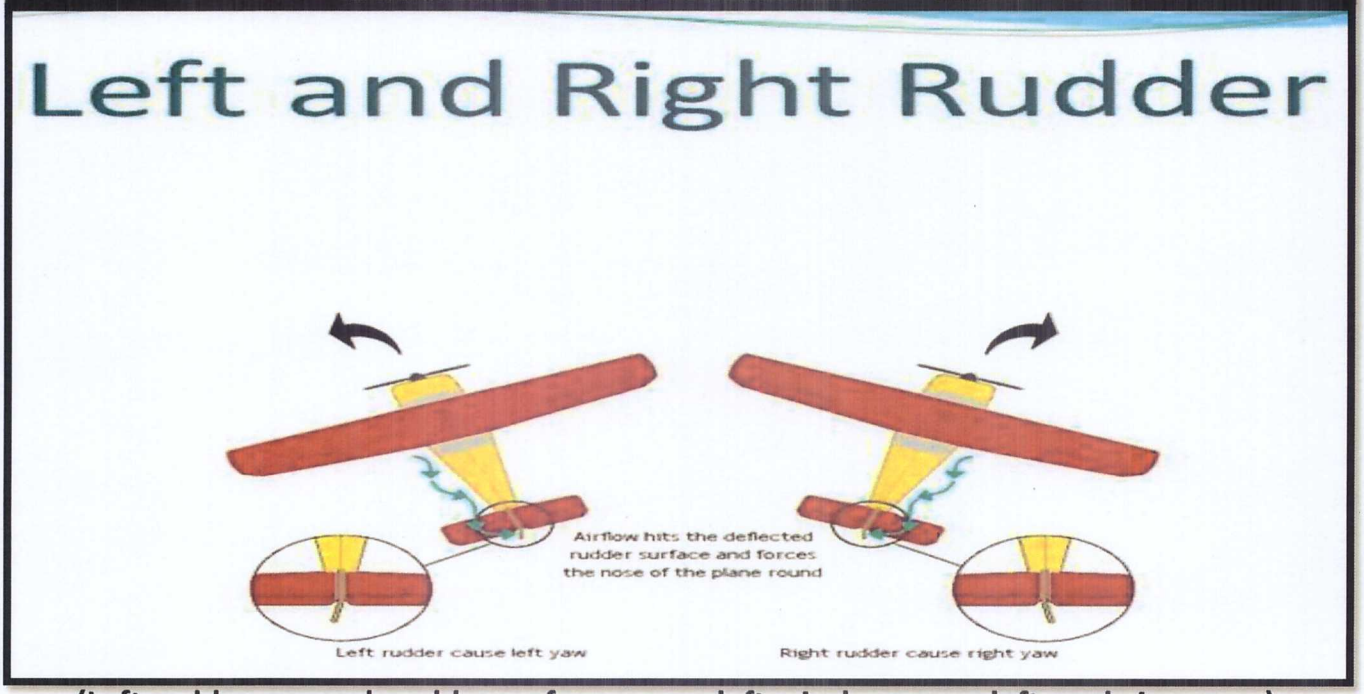
(Vertical and Horizontal stabilizer are fixed, while, rudder and elevator are movable)

NOTE- If the horizontal stabilizer is mounted on top of the vertical stabilizer, it is called a T-tail airplane, forming a T .

Rudder –

- The rudder is attached to the back of the vertical stabilizer and the pilot use it to move the airplane`s nose to the left or right .
- Actually, the pilot uses the rudder and ailerons in combination together during flight to initiate a coordinated turn .
- Pilot operates the rudder with his/her feet, using rudder pedals located in the cockpit .
- when you press the left rudder pedal, the nose moves left, while the right pedal moves the nose to the right .





(Left rudder pressed, rudder surface moves left, airplane nose left, and vice versa)

3) Lateral axes, which is the axis from wingtip to wingtip .

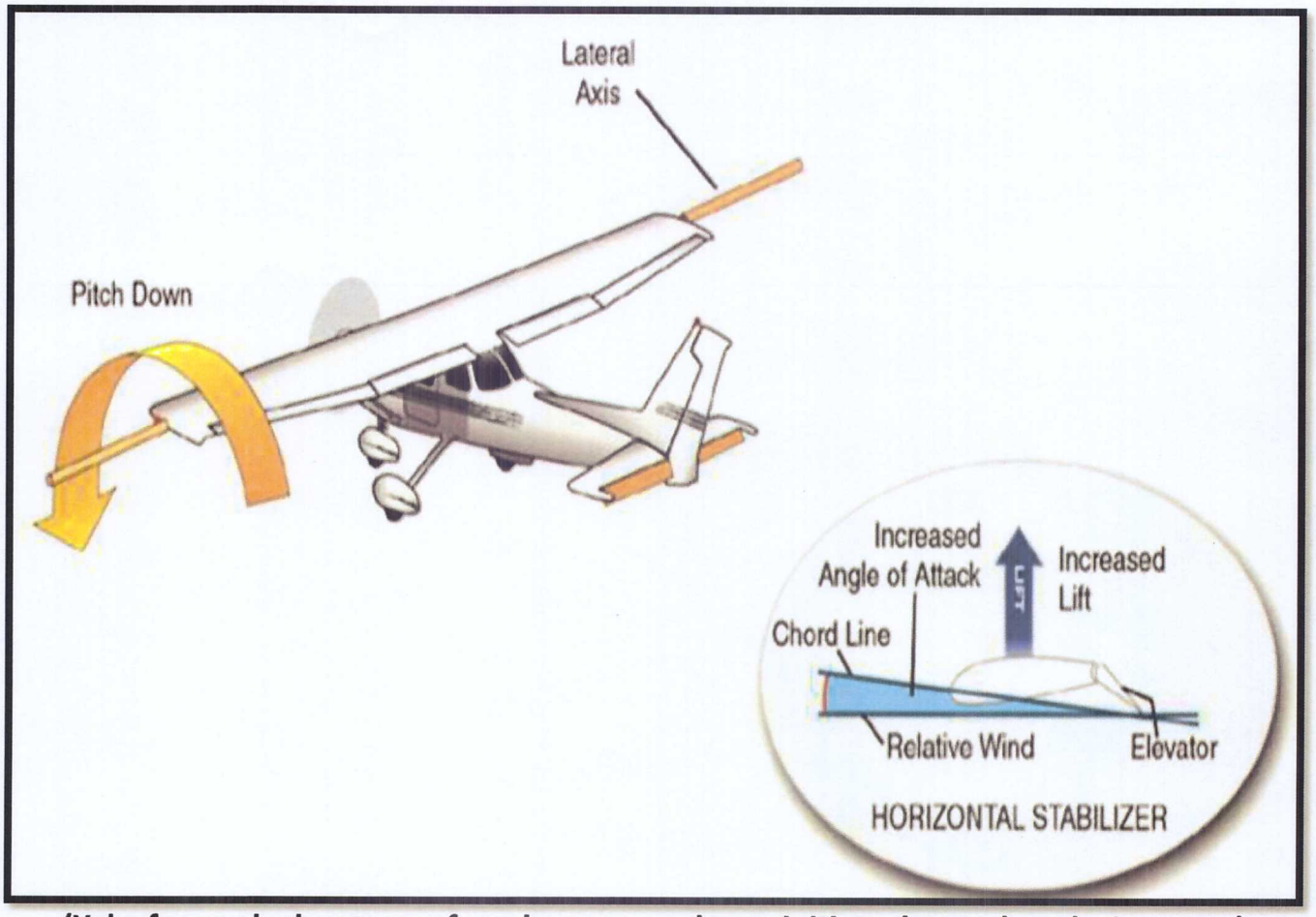
Pitch (climb / descent) –

- The rotation of an airplane about its lateral axis, which is controlled by elevator .

Elevator –

- The elevator which is attached to the back of the horizontal stabilizer, is used by pilot during flight to move the nose of the airplane up (climb) or down (descent) to the desired altitude .

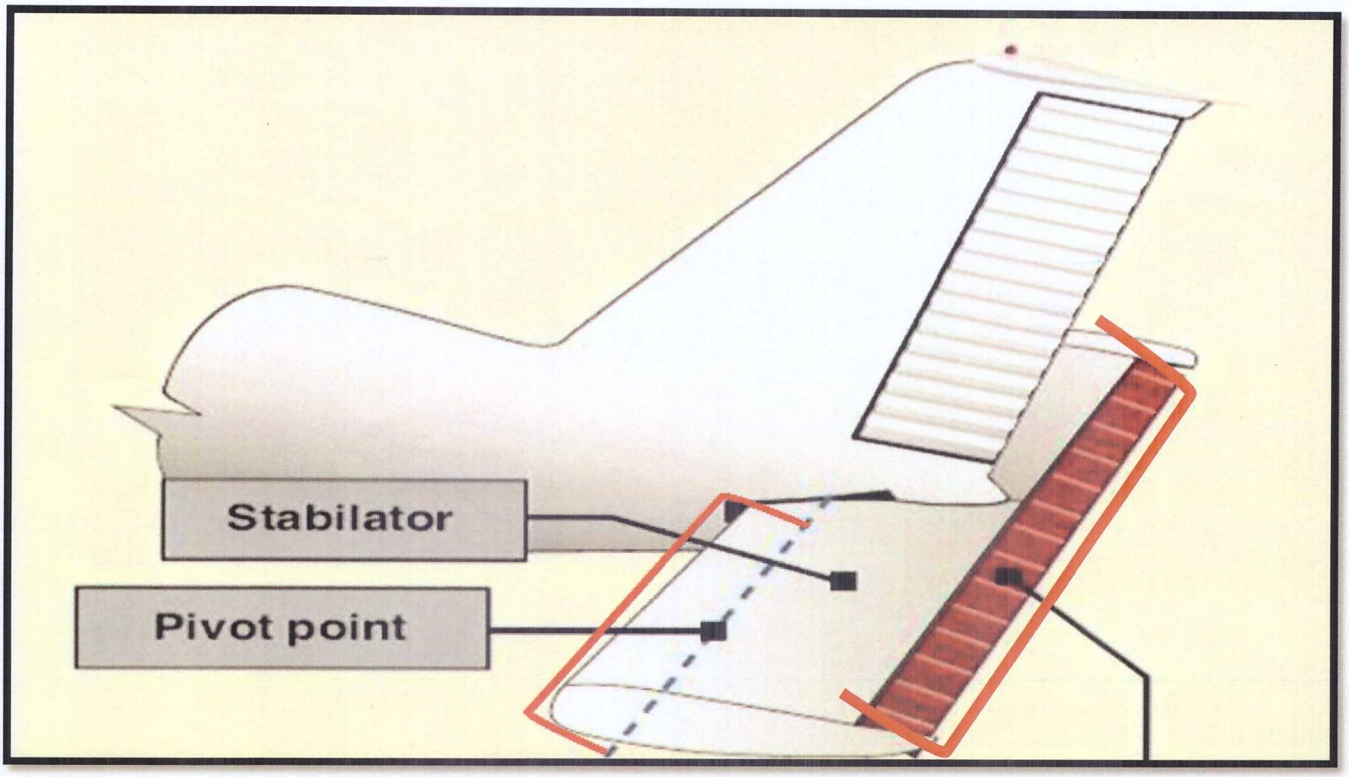
- The elevator is moved by using the yoke, when pilot pulls back on the yoke, the nose moves up, and when you push forward, the nose moves down .



(Yoke forward, elevator surface down, nose down, initiate descend, and, vice versa)

Stabilator –

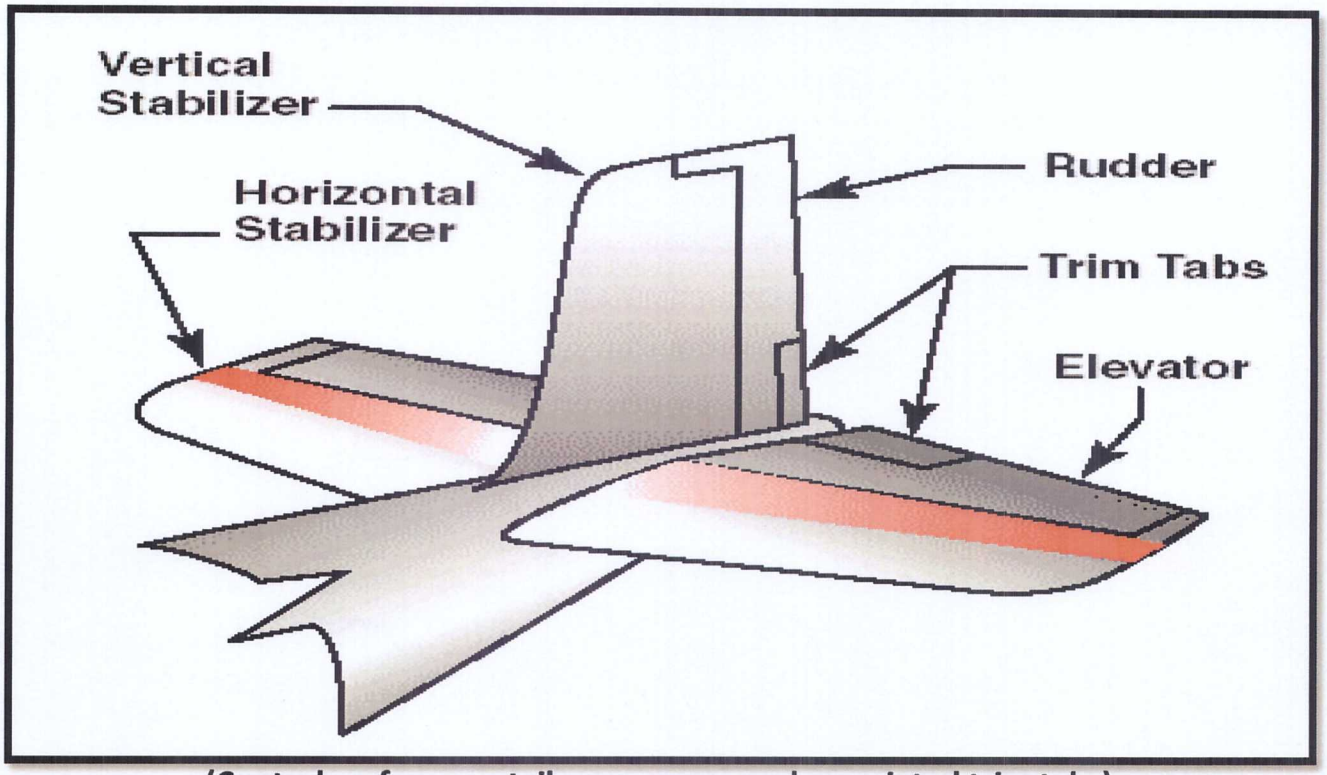
The second type of empennage design, does not require an elevator, instead, they have a one-piece horizontal stabilizer that pivots up and down from a central hinge point. This type of design is called stabilator which is moved up and down by the yoke just like elevator .



Trim tabs –

- Most airplane have a small, hinged, movable section at the back of each control surface (elevator, rudder, aileron), called a trim tab .
- The control surfaces have a natural live pressure while in flight, and its purpose is to relieve the pressure the pilot must hold on the yoke to keep the airplane in the desired position .
- The pilot controls the trim tabs by a wheel or crank in the cockpit .

The trim sequence is : 1) elevator 2) rudder 3) ailerons



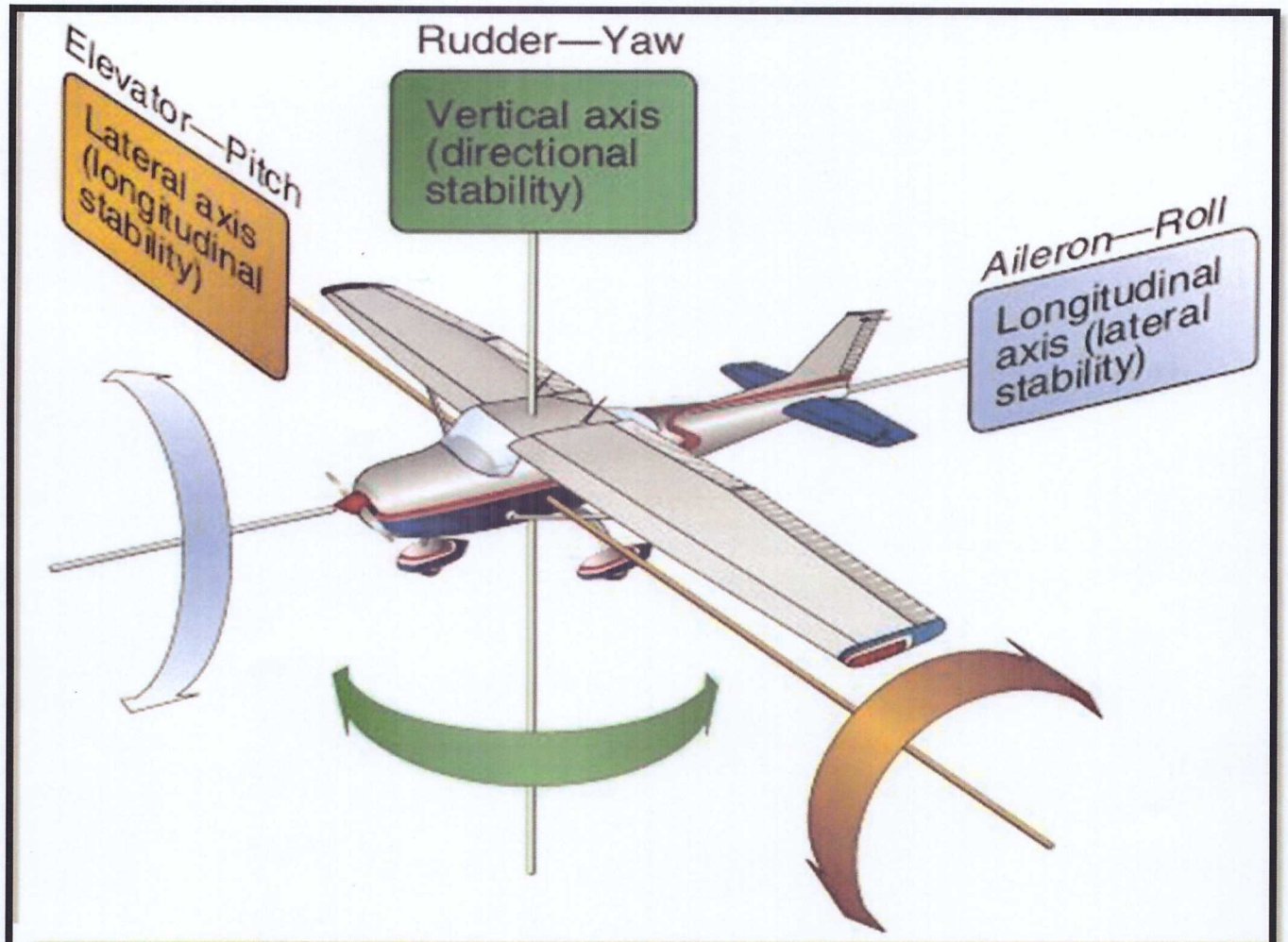
(Control surfaces on tail empennage and associated trim tabs)

Auto-pilot –

- An automatic flight control system (AFCS) is a system used to control of an aircraft without constant ``hands-on`` by pilot .

(Auto-Pilot control panel)

An overview to airplane control surfaces, it`s movement and axes of rotation around :



Primary Control Surface	Airplane Movement	Axes of Rotation
Aileron	Roll	Longitudinal
Elevator/ Stabilator	Pitch	Lateral
Rudder	Yaw	Vertical

Flight instruments -

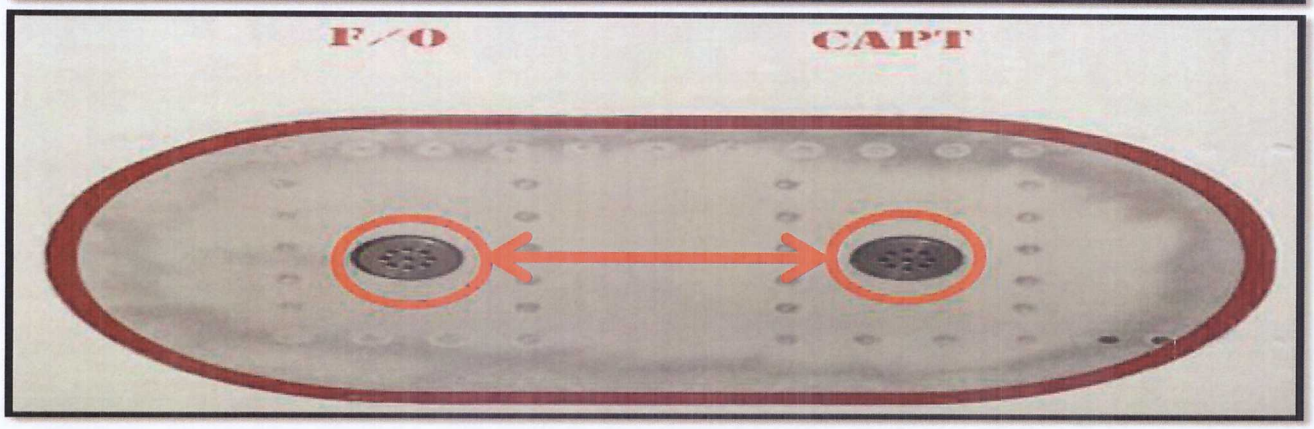
- Are the instruments in the cockpit that provide the pilot with information about the flight situation of that aircraft, such as altitude, attitude, airspeed and heading (direction) .

- The term ``cockpit instruments`` is used as a whole, in which it can include engine instruments, navigational and communication equipment .

(A typical complex of cockpit instrument)

Flight instruments comprises of two types of instruments :

1) differential-pressure instruments, and, 2) gyroscopic instruments .



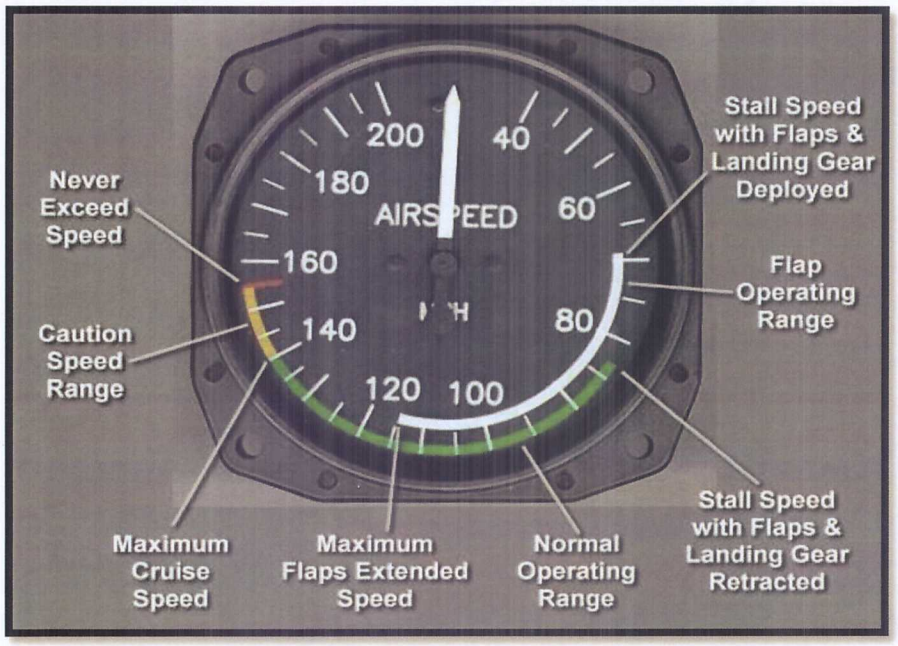
(Pitot and static systems are the main sources for differential pressure instruments)

Differential pressure instruments include :

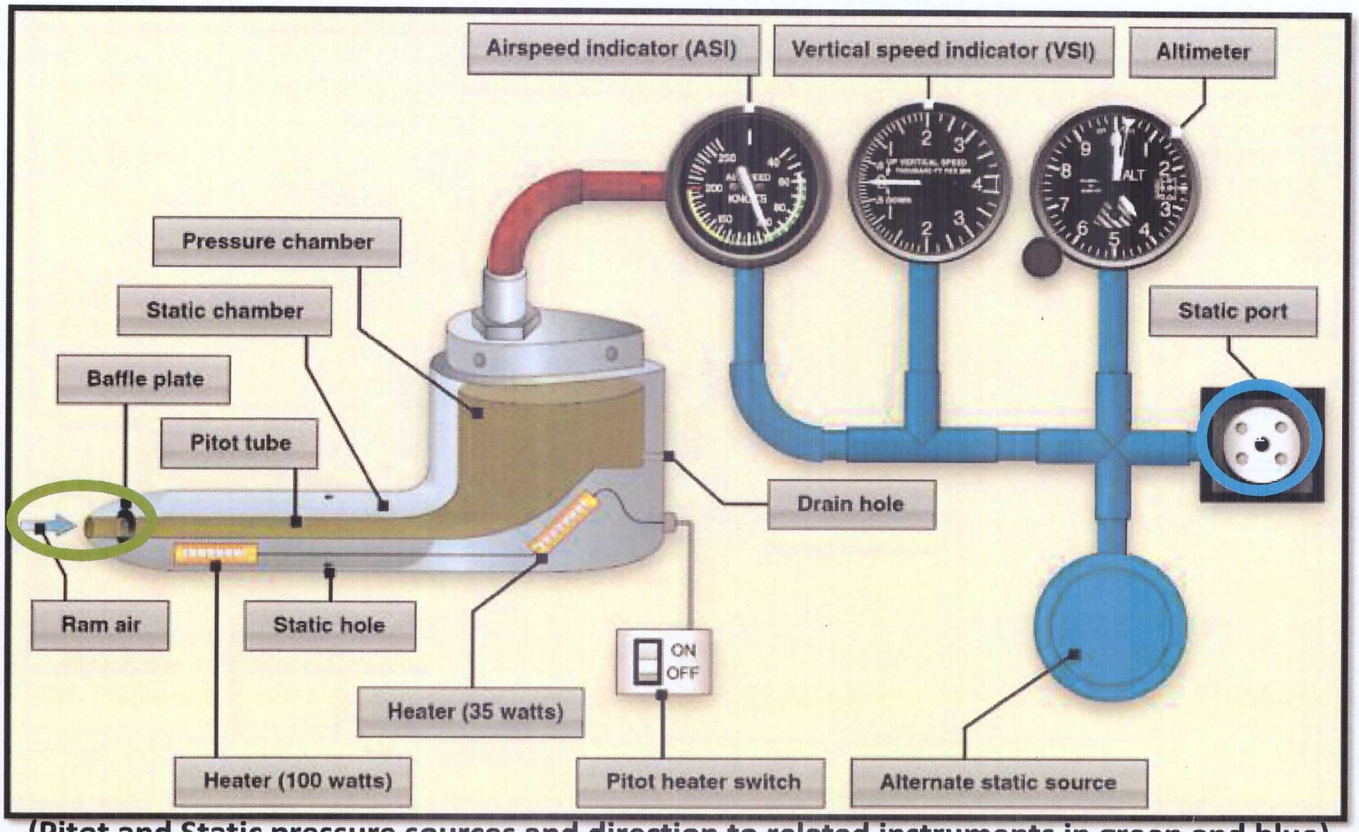
1) Altimeter for showing the altitude of the airplane ;

2) Vertical Speed Indicator (VSI) / Vertical Velocity Indicator (VVI), to indicate the rate of climb or descent of the airplane in feet per minute .

3) Airspeed indicator to provide the speed of the airplane relative to the air, which is, divided into color-coded arcs that define speed ranges for different phases of flight .



- **Pitot pressure is directed only to the airspeed indicator, while static pressure, is directed to all three instruments .**

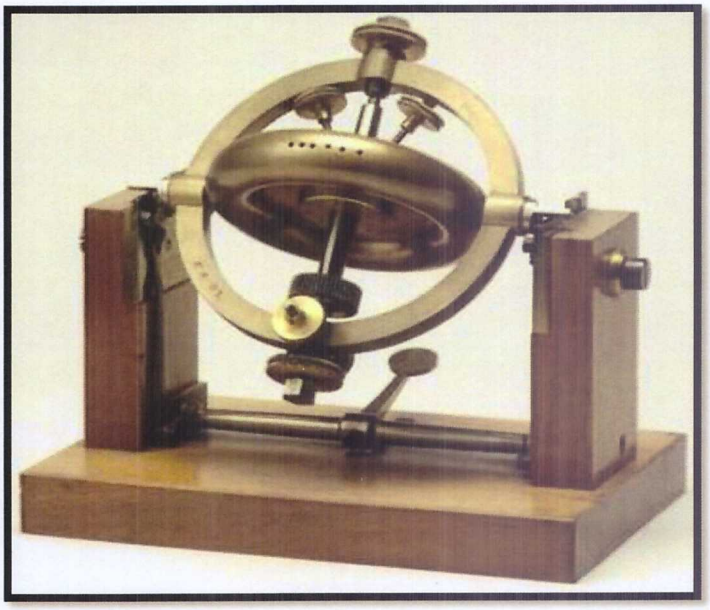


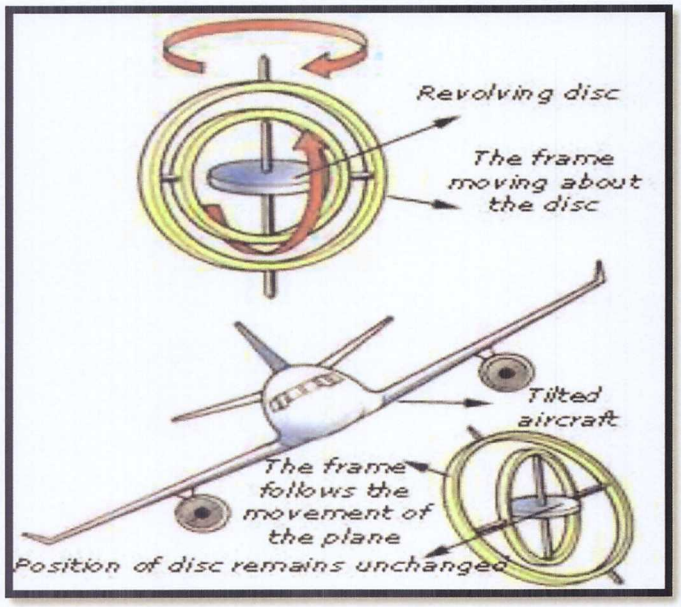
(Pitot and Static pressure sources and direction to related instruments in green and blue)

- The pitot-static system are subject to total or partial blockage by moisture, ice, dirt, or insects, which blockage of each system will adversely affect instrument operation .
- During preflight, the pilot should make sure that the pitot cover is removed and the pitot and static port opening should be clean .
- It is also possible for the pitot tube to become blocked during flight through visible moisture when the temperature is near the freezing level, in this case, if the airplane is equipped with pitot heat, the pilot should turn it on to prevent pitot tube icing .

Blockages in Pitot-Static System

- Blocked Pitot System
  - Affects Airspeed Indicator (ASI) only
    - clogged pitot tube with clear drain hole shows zero airspeed
    - clogged pitot tube with clogged drain hole shows airspeed varying with altitude
- Blocked Static System
  - Affects all pitot-static instruments
    - ASI = inaccurate airspeed indications
    - VSI = constant zero indication
    - ALT= frozen at altitude where blockage occurred

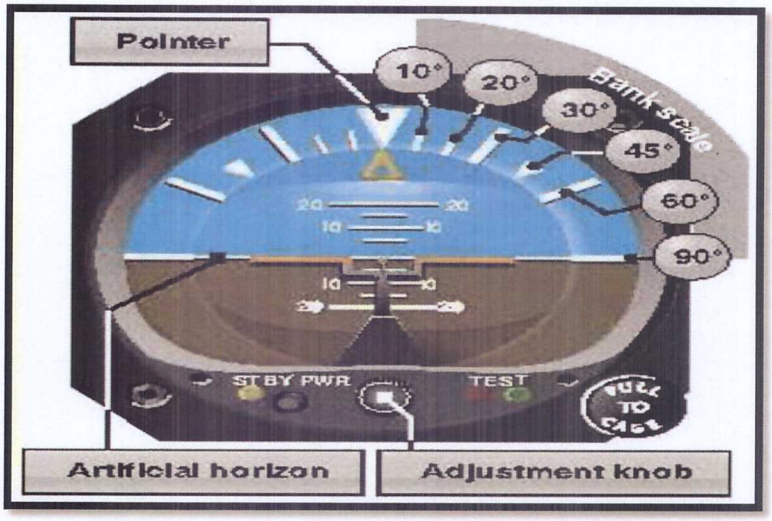




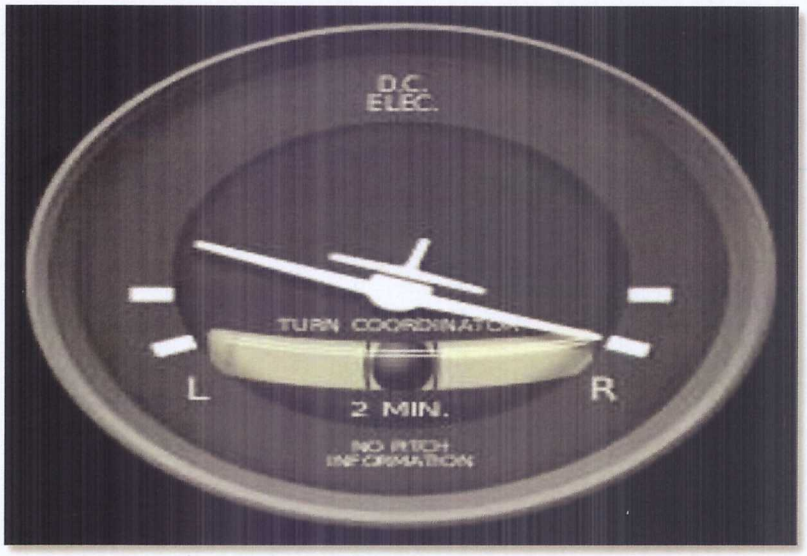
(Gyroscope is a device for measuring or maintaining orientation by gyroscopic instruments)

Gyroscopic instruments includes :

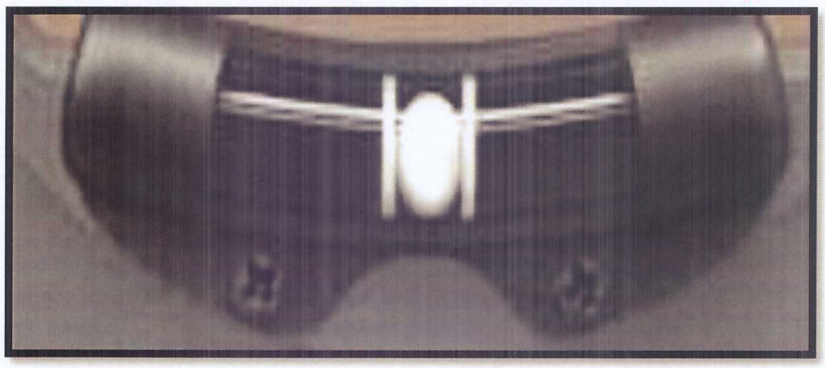
1) Attitude indicator to sense the climb/descent and roll (turn) of the airplane ;



2) Turn coordinator to indicate the yaw and turn of the airplane ;



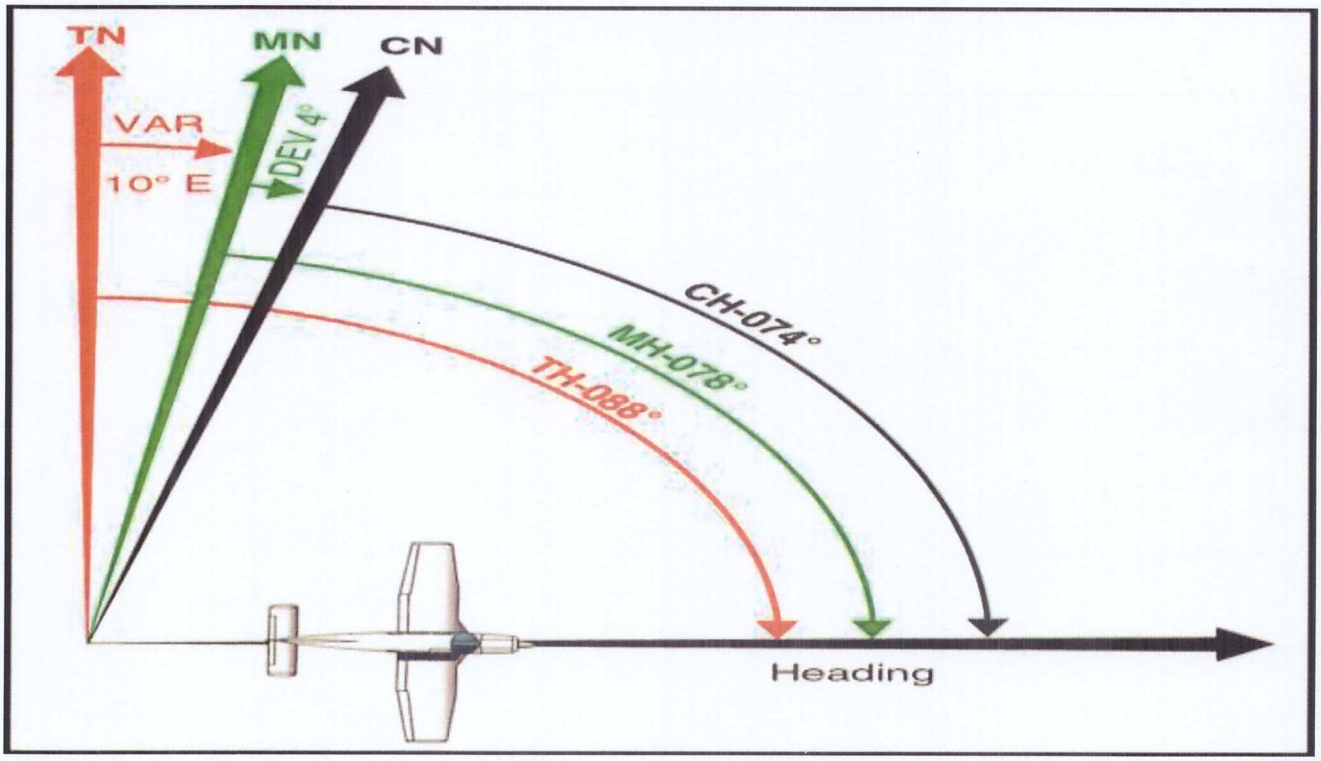
3) Inclinometer to show the quality of a turn (coordinated, Slip or Skid) ;



4) Heading indicator to display the heading of the airplane ;

Heading –

- The direction in which the longitudinal axis of the airplane points measured clockwise from true or magnetic north .



Variation -

- Is The angular difference between true north and magnetic north; indicated on charts by isogonic line .

Stand-by or emergency compass,
is a device for determining the heading of the airplane measured from compass north

Radio altimeter/radar altimeter –

- Equipment which makes use of the reflection of radio waves from the ground to determine the height of the aircraft above the surface .

Knot –

- Knot, pronounced ``NOT``, is a unit of speed, used in aviation, equal to one nautical mile (NM), or 1.852 km, or 1852 meters .

Nautical mile (NM) –

- is a unit of length or distance, equal to 1852 meters or 6076 feet

Indicated airspeed (IAS) –

- IAS is the airspeed reading directly from the airspeed indicator .

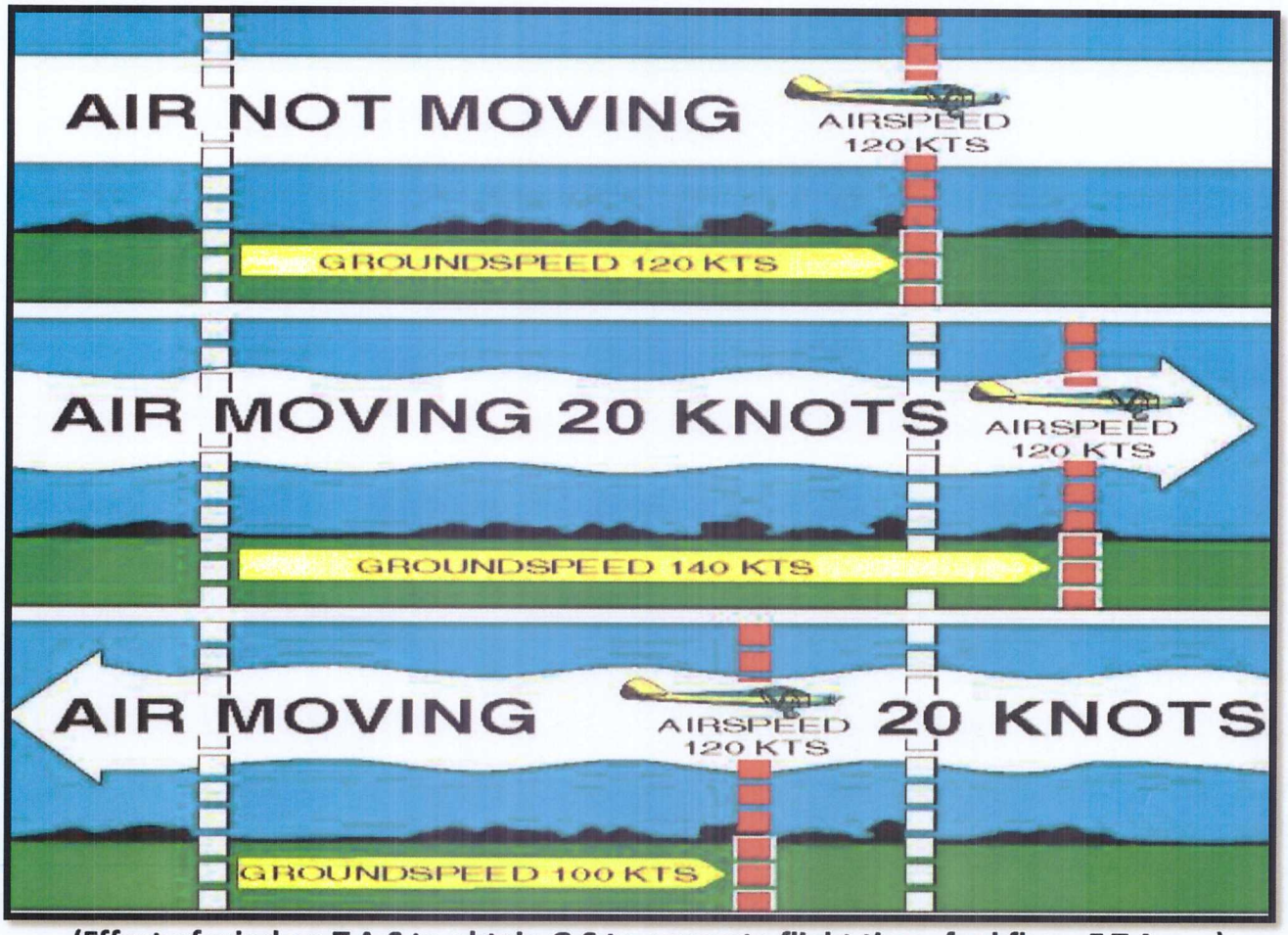
True airspeed (TAS) –

- The true airspeed of an aircraft is the speed of the aircraft relative to the air mass in which it is flying.

Groundspeed (GS) –

- GS is TAS corrected for the wind, and, represents the actual speed of the airplane over the ground .

- The headwind decreases the groundspeed, while a tailwind increases it .



(Effect of wind on T.A.S to obtain G.S to compute flight time, fuel flow ,E.T.A,.....)

Weight –

- Weight, or gravity, is the actual weight of the airplane, termed one-G, it always acts downward, toward the center of the earth, opposite of the lift due to the downward pull of gravity .

- Before an aeroplane can leave the ground and fly, the force of weight must be balanced by a force called lift which acts upwards .

Thrust –

- Is a mechanical force which opposes the drag to move the aircraft through the air .

Power plant –

- The power plant includes both the engine and propeller combination with accessories whose purpose is to provide trust to make the aircraft go forward .

Engine –

- The engine drives the propeller which, in turn, produces the trust, and also, provides electrical power, a vacuum source, and heat for the cabin .

- The throttles and mixture are the only two primary engine controls.

- The throttle controls engine speed by regulating the amount of fuel and air that flows into the cylinder, while the mixture controls the ratio of the fuel-to-air mixture .

Revolutions Per Minute (R.P.M) –

- Engine speed expressed in RPM and is displayed on an instrument called tachometer.

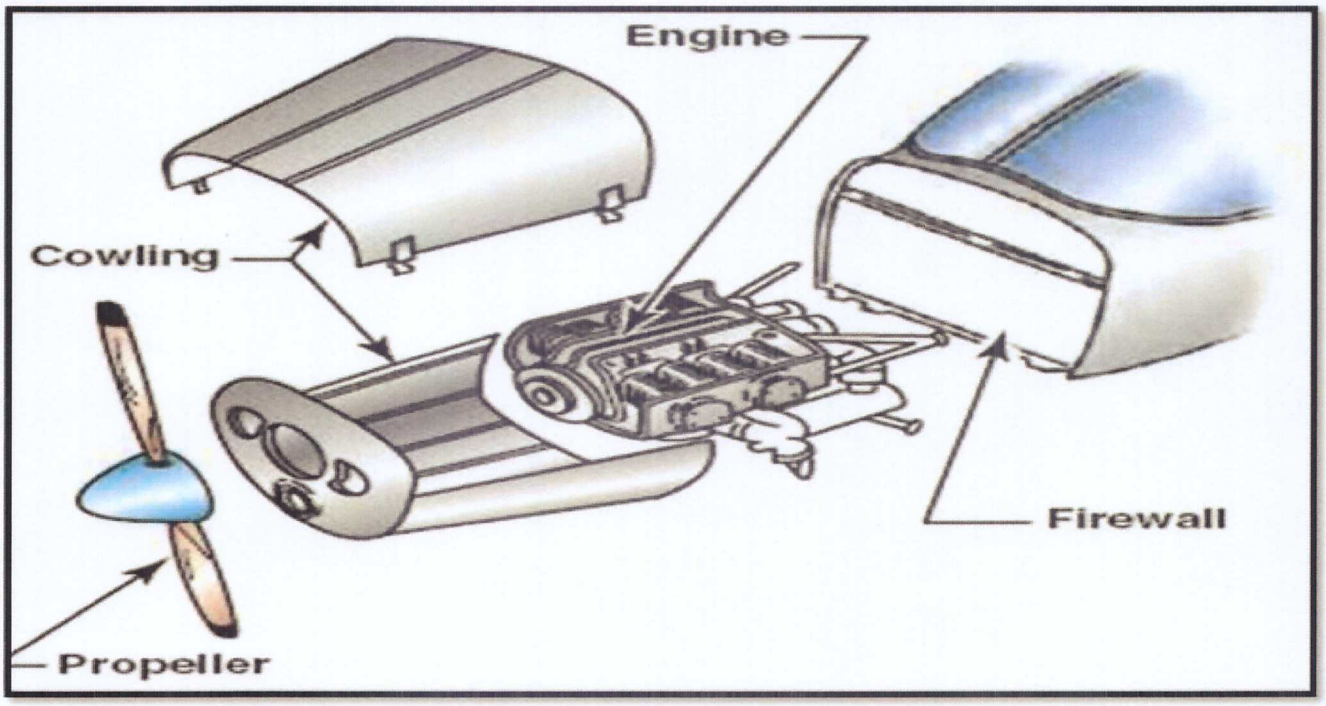
Idle:

- The state of an engine when it is running but not delivering power to move the aircraft .

Types of engines :

Turbo-Fan Engine, Turbo-Prop Engine , Turbo-Jet Engine

- Training airplanes are normally powered by reciprocating engines (piston engine) , which get their name from the back-and-forth movement of the piston .



Propeller –

- Propeller is a device for propelling aircraft that, when rotated, produces a trust .

Cowlings –

- Cowling is access to the engine mounted in the wing or fuselage by hinge doors .

Firewall –

- A firewall is located between the engine compartment and the cockpit to protect the occupants, and also, serves as a mounting point for the engine .

Thrust Reversal (Reverse Thrust) -

- Is the temporary diversion of an aircraft engine's exhaust which is directed forward, rather than backwards.

- Reverse thrust acts against the forward travel of the aircraft, providing deceleration during landing .

Drag –

- Opposing the thrust is drag, which is backward, or retarding force that limits the speed of the airplane .

- It is the resistance of the atmosphere to the motion of an aircraft .

Drag is a rearward, retarding force, and is caused by disruption of airflow by the wing, fuselage, and any other external objects of the aircraft .

Drag is classified as either parasite or induced drag .

Parasite drag –

- Is caused by any aircraft surface which deflects or interferes with the smooth airflow around the airplane and increases as airspeed increases .

Induced drag –

- Induced drag is associated with the production of lift and related to angle of attack . it increases as angle of attack increases .

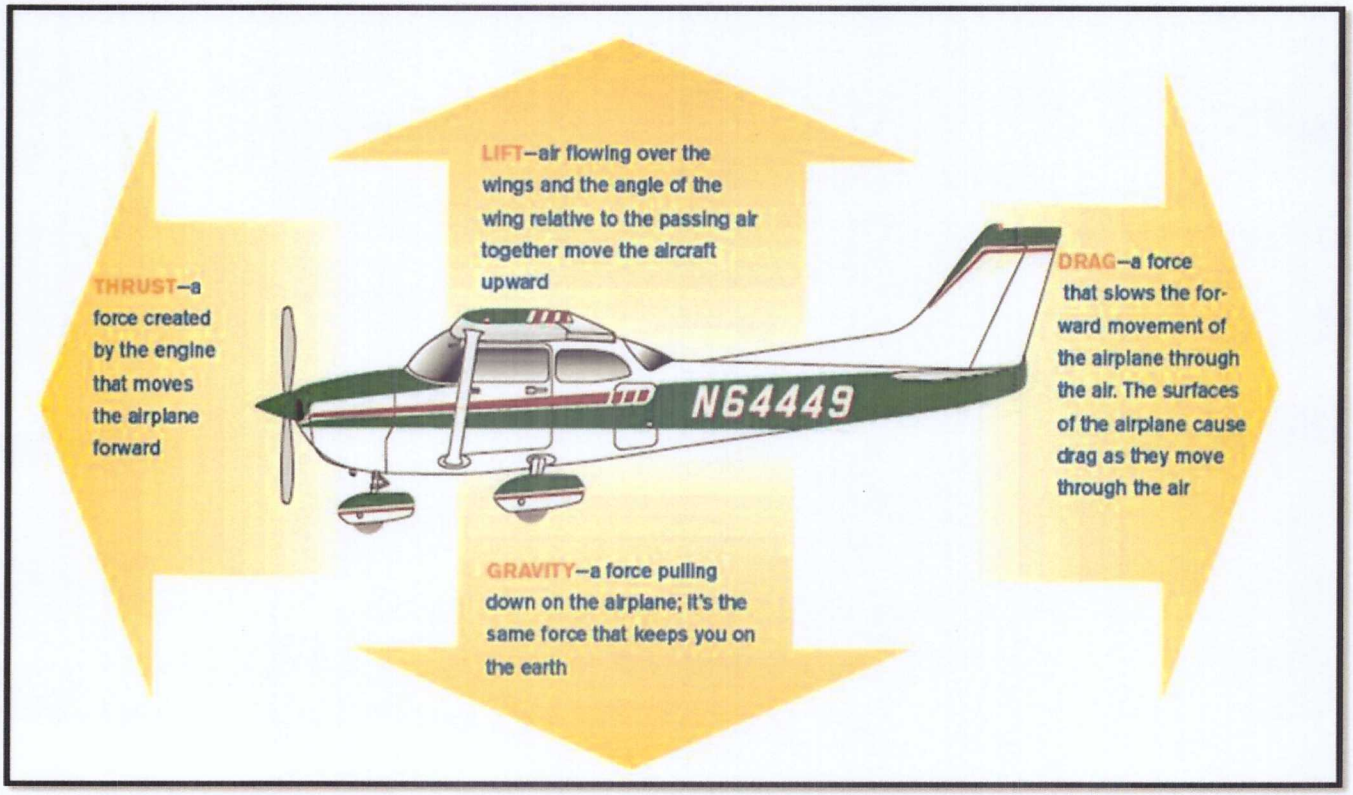
Total drag –

- Total drag for an airplane is the sum of parasite and induced drag .

Lift-to-drag-ratio -

- In aerodynamics, the lift-to-drag ratio (L/D), is the amount of lift generated by a wing, divided by the drag it creates by moving through the air .

How well a pilot performs in flight, depends upon the ability to plan and coordinate the use of the power and flight controls for changing the force of thrust, drag, lift, and weight . it is the balance of between these forces that a pilot must always control .



Landing gear –

- The landing gear is a principle support of the airplane when parked, taxing, taking off, or, landing .

- Landing gear consists of three sets of wheels, two sets are main wheels which are located on either side of the fuselage, and, the third set may be positioned either at the nose or at the tail .

- If the third set is located at the tail, it is called a tail wheel, and in this case, the airplane is said to have conventional landing gear .

- When the third set of wheel is located at the nose, it is called a nose wheel, and, the airplane is said to have tricycle landing gear .

- It is steerable and the pilot can control the airplane in all operations on the ground by this wheel by use of rudder pedals or steering .

- Landing gear can be classified as either fixed or retractable, where fix landing gear always remains extended, while the retractable gear can be stowed for flight .

- Landing gear control and position indicators are located in the cockpit, mostly shaped like a wheel .

Configuration -

- A term, which normally refers to the position of the landing gear and flaps .

Clean configuration -

- Clean configuration is referred to when the landing gear and flaps are retracted , and,

Landing configuration -

- Landing configuration is referred to when the landing gear and flaps are extended .

Shock struts –

- Shock struts are designed for this purpose to absorb bumps and jolts as well as the downward force of the airplane landing .

Brakes –

- Airplane brakes operate on the same principles as automobile, but they do have a few significant differences such as :

1) Airplane brakes usually are located only on the main wheels;

2) The brakes are applied by separate pedals, so the pilot can operate the brakes on the left independent of the brakes on the right, or vice versa . this capability is called ``differential braking .

- It is important during ground operations, when the pilot needs to supplement to nose wheel steering, he can apply the brakes on the side toward the direction of turn .

Aerodrome –

- A defined area on land or water including any buildings, installations, and equipment intended to be used for the arrival, departure and surface movement of aircraft .

Airport beacon light –

- Airport beacons are used to guide pilots to lighted airports, and are either rotating or flashing type .

Apron –

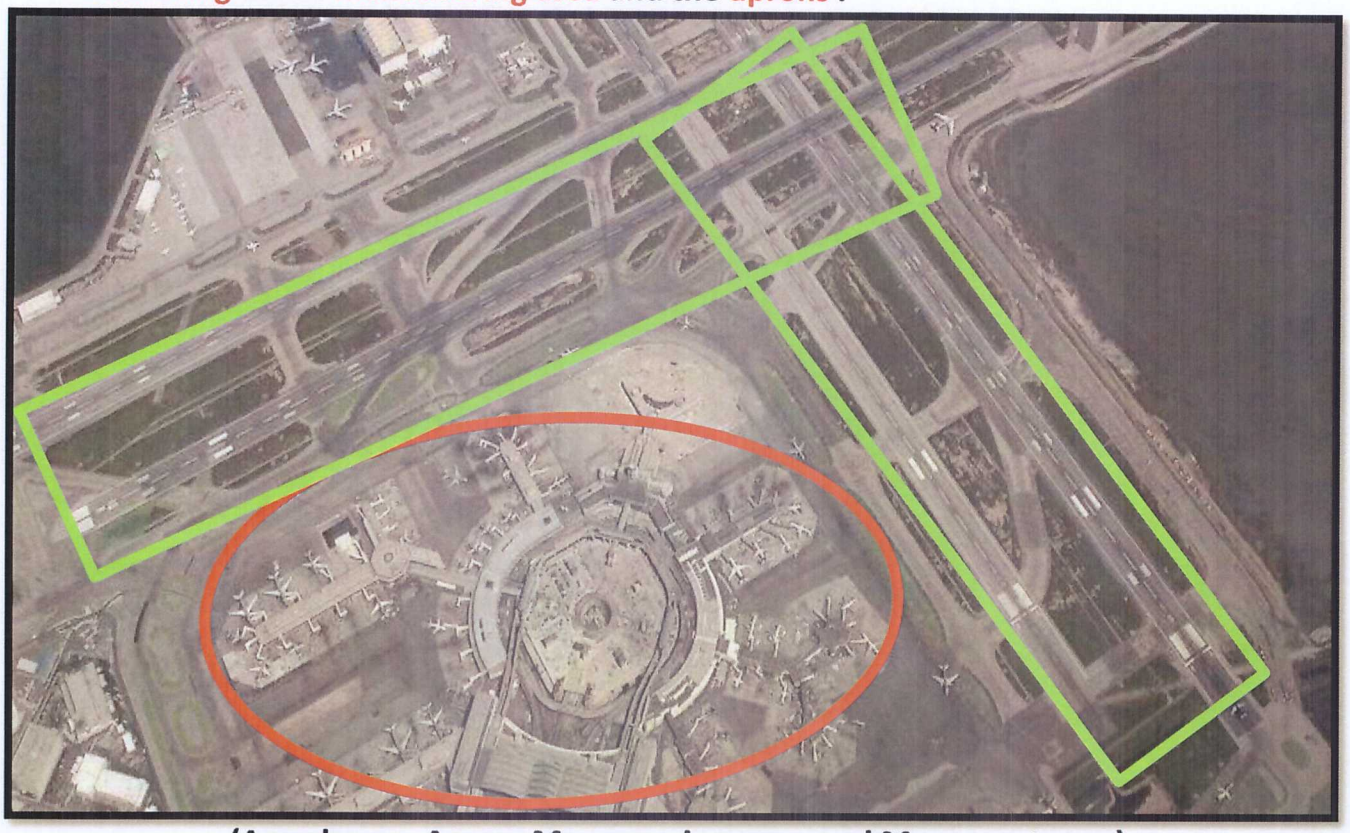
- A defined area, on a land aerodrome, intended to accommodate aircraft for the purpose of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance .

Maneuvering area –

- That part of an aerodrome to be used for the takeoff, landing and taxiing of aircraft, excluding aprons (runway and taxiway) .

Movement area –

- That part of an aerodrome used for the take-off, landing and taxiing of aircraft, consisting of the maneuvering area and the aprons .



(Aerodrome, Apron, Maneuvering area, and Movement area)

Taxiing –

- Movement of an aircraft on the surface of an aerodrome under its own power, excluding takeoff and landing .

Taxiway –

- A defined path on a land aerodrome established for the taxiing of an aircraft and intended to provide a link between one part of the aerodrome and another .

NOTE -Taxiway lights, are blue lights which indicate the taxiway edge .

- Towing is pulling the airplane forward, and, push-back is pushing the airplane backwards by another vehicle .

Runway -

- A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft .

Runway holding position (point)-

- A designated position at which taxiing aircraft shall stop and hold, unless authorized by the aerodrome control tower .

Runway center line marking (RCLM)–

- White runway centerline marking located between runway direction number, identifies the center of the runway and provides alignment guidance during takeoff and landing operation .

Runway threshold / Threshold marking -

- Are markings across the runway that denote the beginning and end of the designated space for landing and takeoff .

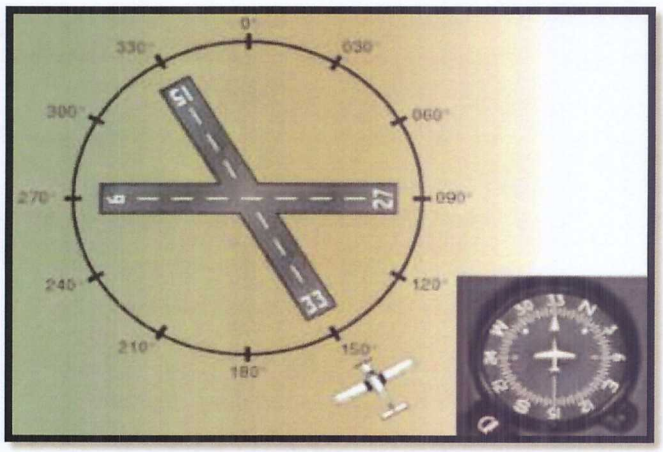
Displaced threshold –

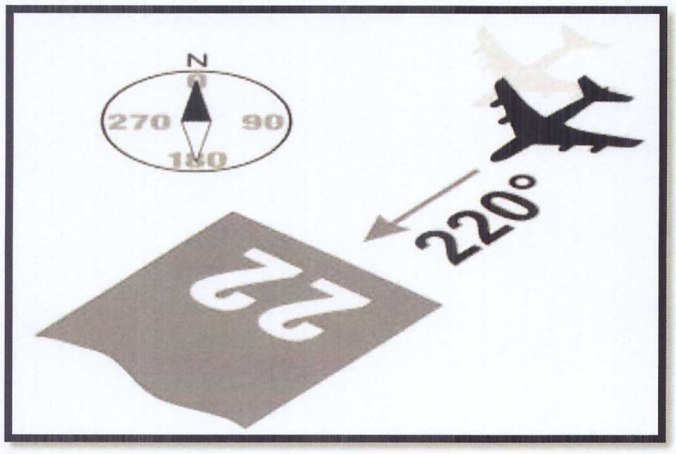
- A threshold that is located at a point on the runway other than the designated beginning of the runway .

Runway Edge Line / Runway Edge Light / Runway Approach Light System

Runway direction number –

- Runway direction numbers are derived from the runway`s direction (heading) in degrees relative to magnetic north .





- If there are two parallel runways, one is labeled the left runway and the other is the right; for example, `` 28L, 28R/ 29L, 29R`` .

- If there is a third parallel runway, the one in the middle is the center runway; for example, `` 36L, 36C, 36R / 19L, 19C, 19R .

Tetrahedron/wind sock –

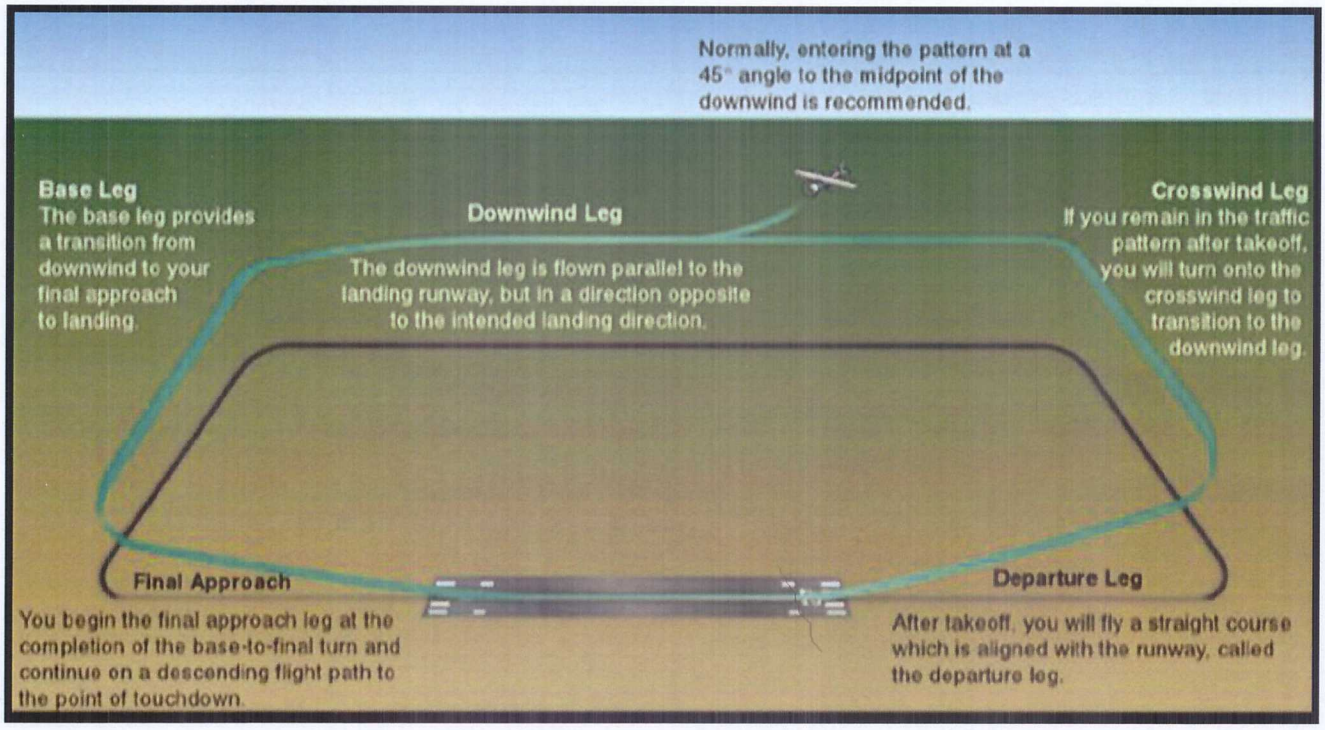
- Tetrahedron is a large, triangular-shaped, kite-like device installed near the runway, which are free to swing with the wind to show the pilot the direction of the wind as an aid in takeoffs and landings .

Aerodrome control tower –

- A unit established to provide air traffic control service to aerodrome traffic, and issuance clearance for aircraft taking-off and landing .

Aerodrome traffic pattern –

- The standard rectangular traffic pattern for the traffic flow that is designed for aircraft landing and taking off from an airport . they are the upwind or departure leg, crosswind, downwind, base leg, and the final approach .



(When turns are made to the left, the pattern is known as ``left traffic pattern``)

Overshoot/ Undershoot –

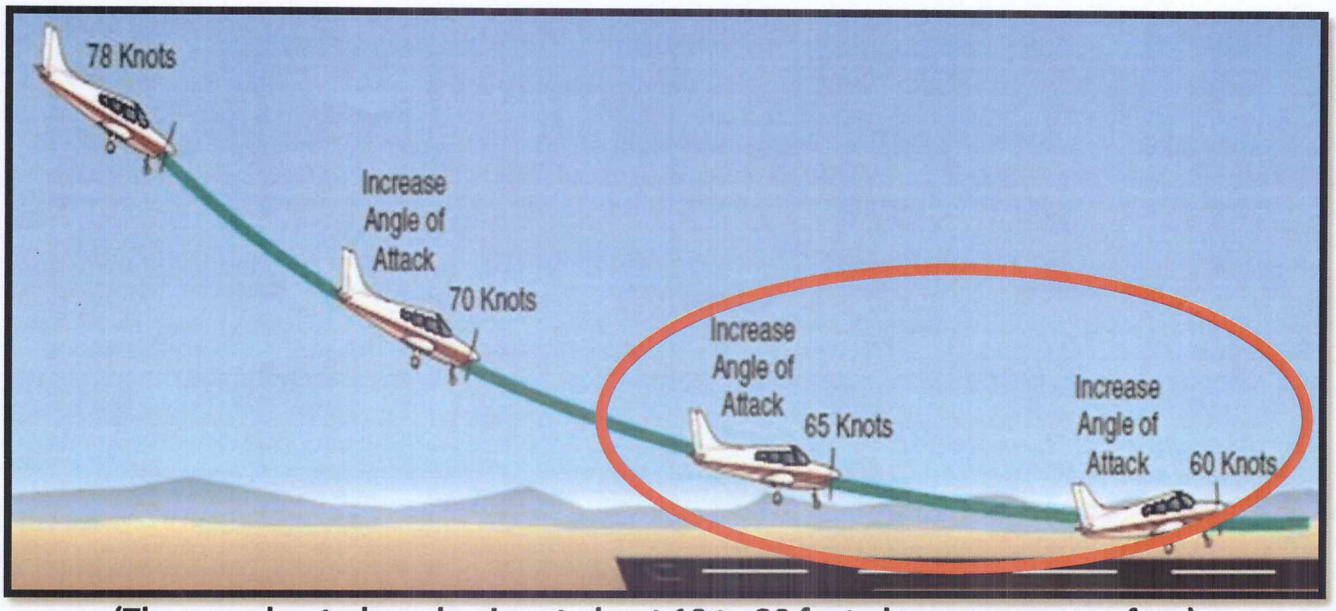
- A phase of a traffic pattern during turning to final leg in which a landing approach of an airplane is not continued to the center line .

The last part of the final is divided into three phases :

1) Round-out (flare); 2) Touch-down and; 3) After landing roll

Round out (flare) –

- Round out is a pitch-up attitude during landing approach to reduce the rate of descent and the airspeed prior to touch down .



(The round out phase begins at about 10 to 20 feet above runway surface)

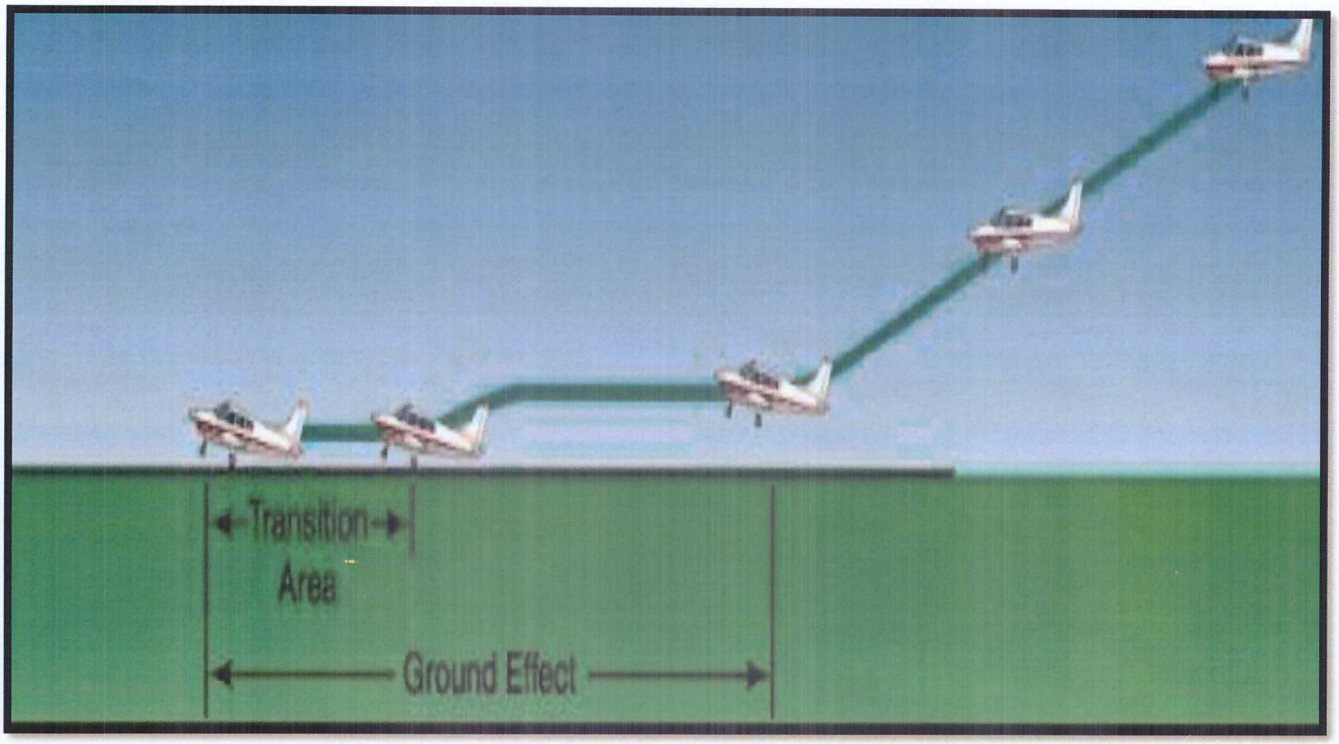
Touch down –

- The touch down is a Phase of gentle settling of the airplane onto the runway .

Touch-and-go landing –

- A touch and go landing or remaining in traffic pattern, is a maneuver that is very common when learning to fly an airplane .
- It is landing on a runway and taking off again without coming to a full-stop .
- this allows many landings to be practiced in a short time .

- If the pilot brings the airplane to a full-stop before taking off again, it is known as a ``full stop`` .



(Touch-And-Go landing and transition area)

Go-arounds (Rejected landings) –

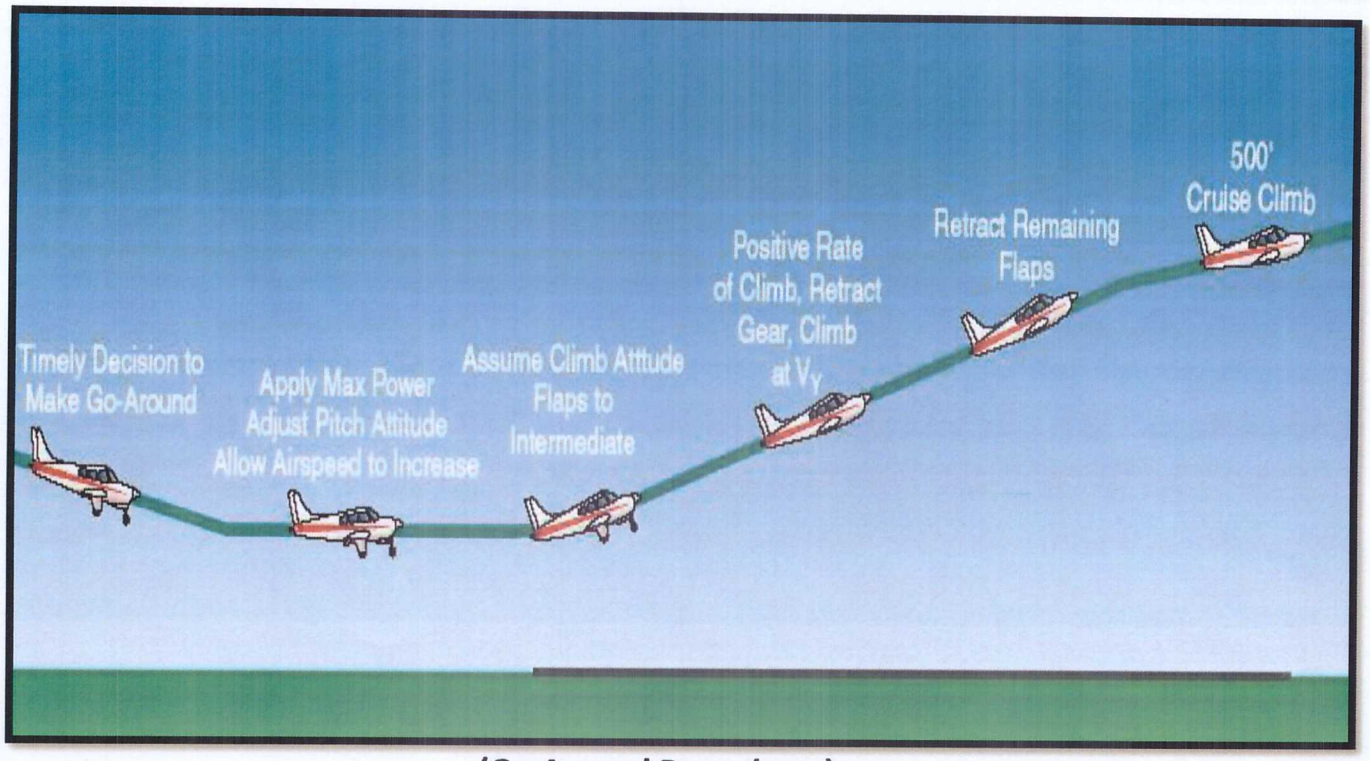
- Whenever a landing conditions are not satisfactory for the pilot, a go-around is warranted .

- if a landing cannot be made on the first third of the runway, or the airplane drifts sideways, the pilot should :

`` EXECUTE A GO-AROUND IMMEDIATELY ``

Factors affecting to the unsatisfactory landing conditions :

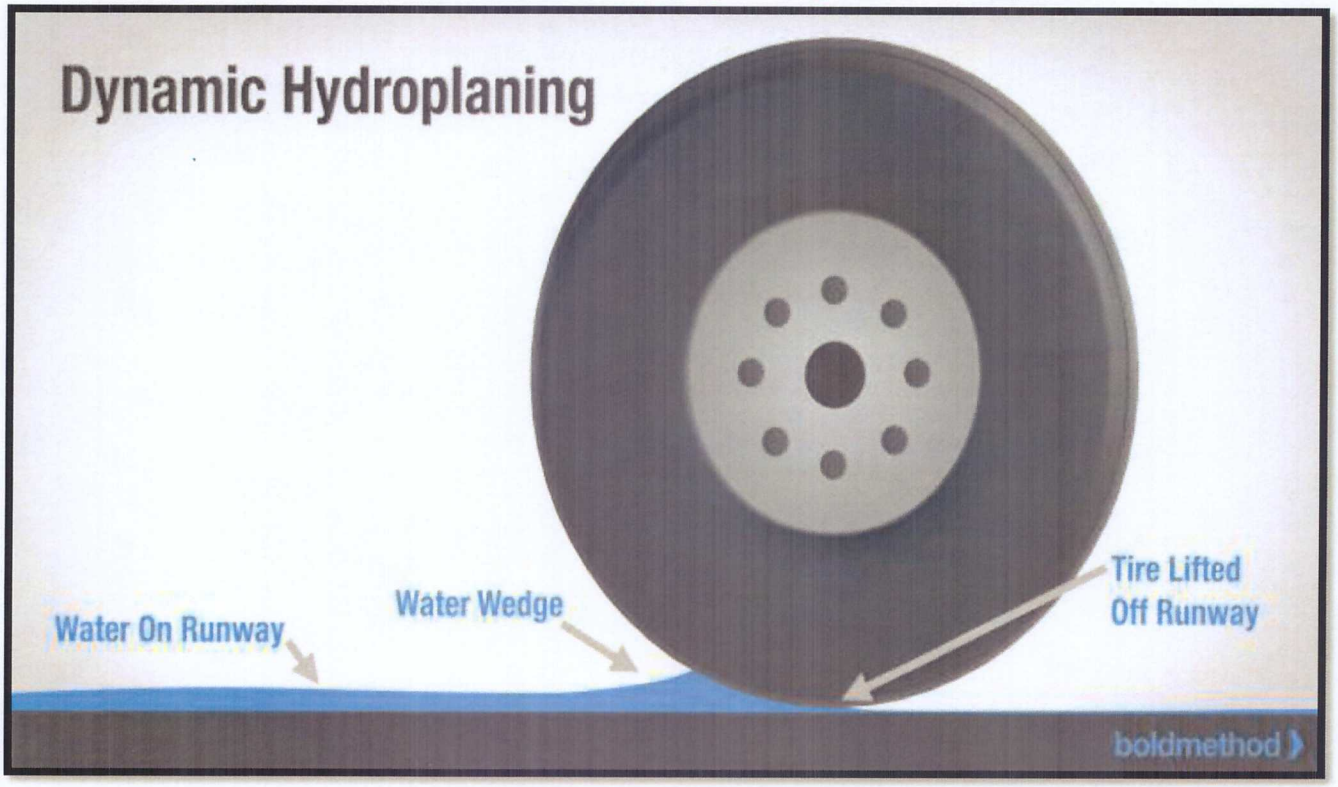
Air traffic control requirements/ unexpected appearance of hazards on the runway/ overtaking another airplane/ wind shear/ wake turbulence/ mechanical failures/ unstabilized approach .



(Go-Around Procedures)

Hydroplaning –

- **Hydroplaning is the condition by the tires of an aircraft occurs when a layer of water builds between the wheels of the aircraft and the runway surface, leading to a loss of traction that prevents the aircraft from responding to brakes inputs.**

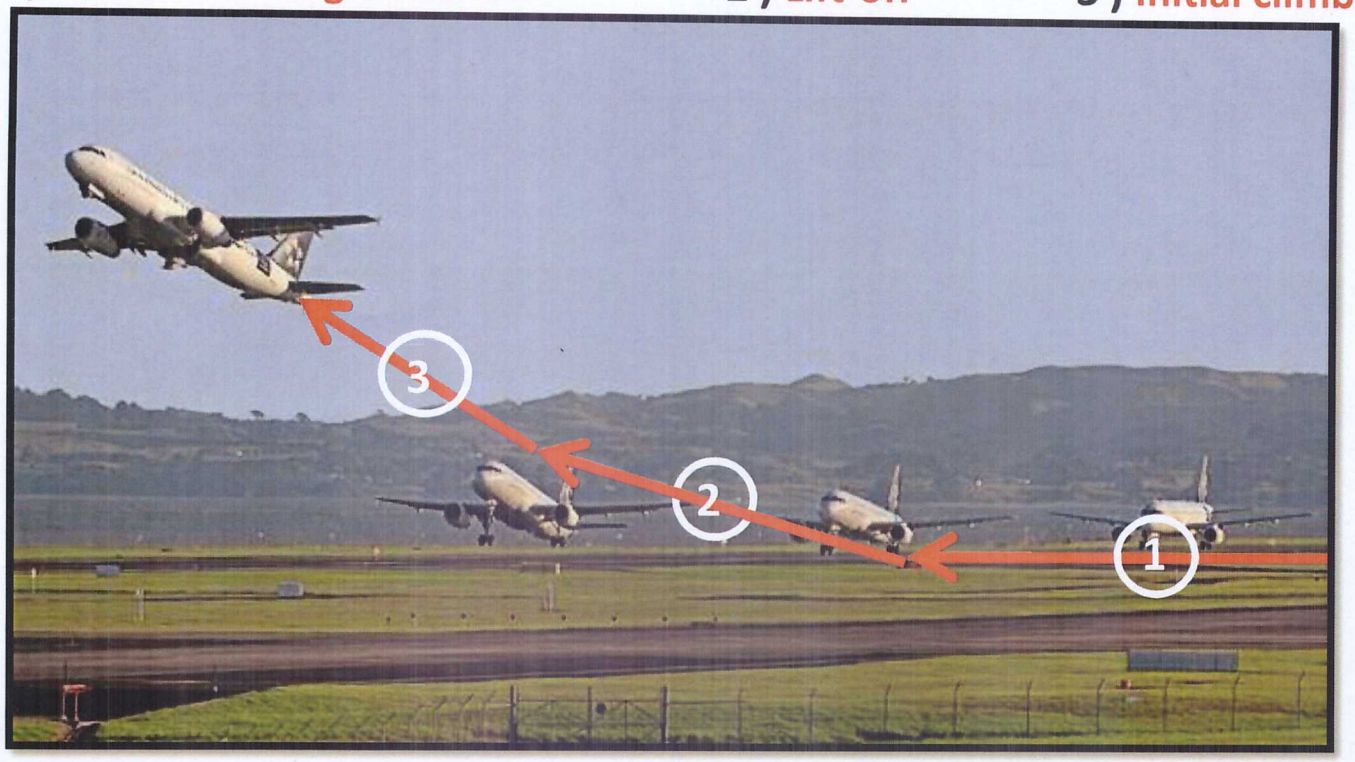


Takeoff -

- Take-Off is the phase of flight in which an aircraft goes from the ground to flying in the air .

- Although the takeoff and climb are one continuous maneuver, it will be divided into three separate steps; they are :

1) Takeoff roll or ground roll 2) Lift-off 3) Initial climb



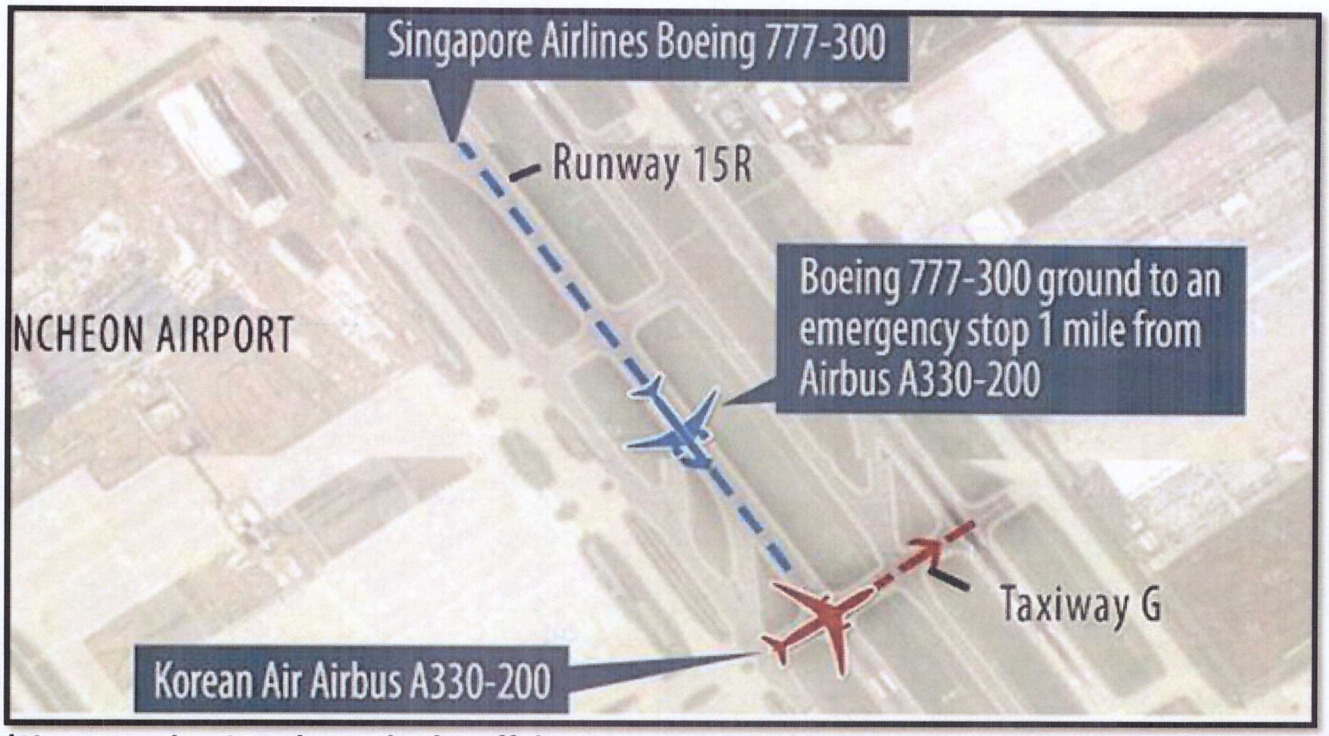
- **Takeoff roll or, ground roll,** is the total distance required for an airplane from starting point to an airspeed to become airborne .

- **Lift-off or, rotation,** is the act of becoming airborne as a result of the wings lifting the airplane off the ground or the pilot rotating the nose up, increasing the angle of attack to start a climb .

- **Initial climb,** begins when the airplane leaves the ground and a pitch attitude has been established to climb .

Rejected (aborted takeoff) –

- If an emergency or abnormal situations occurs during a takeoff while the airplane is still on the ground, the pilot must discontinue and reject/abort the takeoff .



(Singapore boeing aborted take off due to unexpected Korean airbus appeared on runway)

Air navigation -

- Is defined as the process of determining the position of an aircraft and maintaining its desired direction relative to the surface of the earth .

- When the function of air navigation is performed with using " radio aids" , Then the pilot is perfoming a " radio aids navigation ".

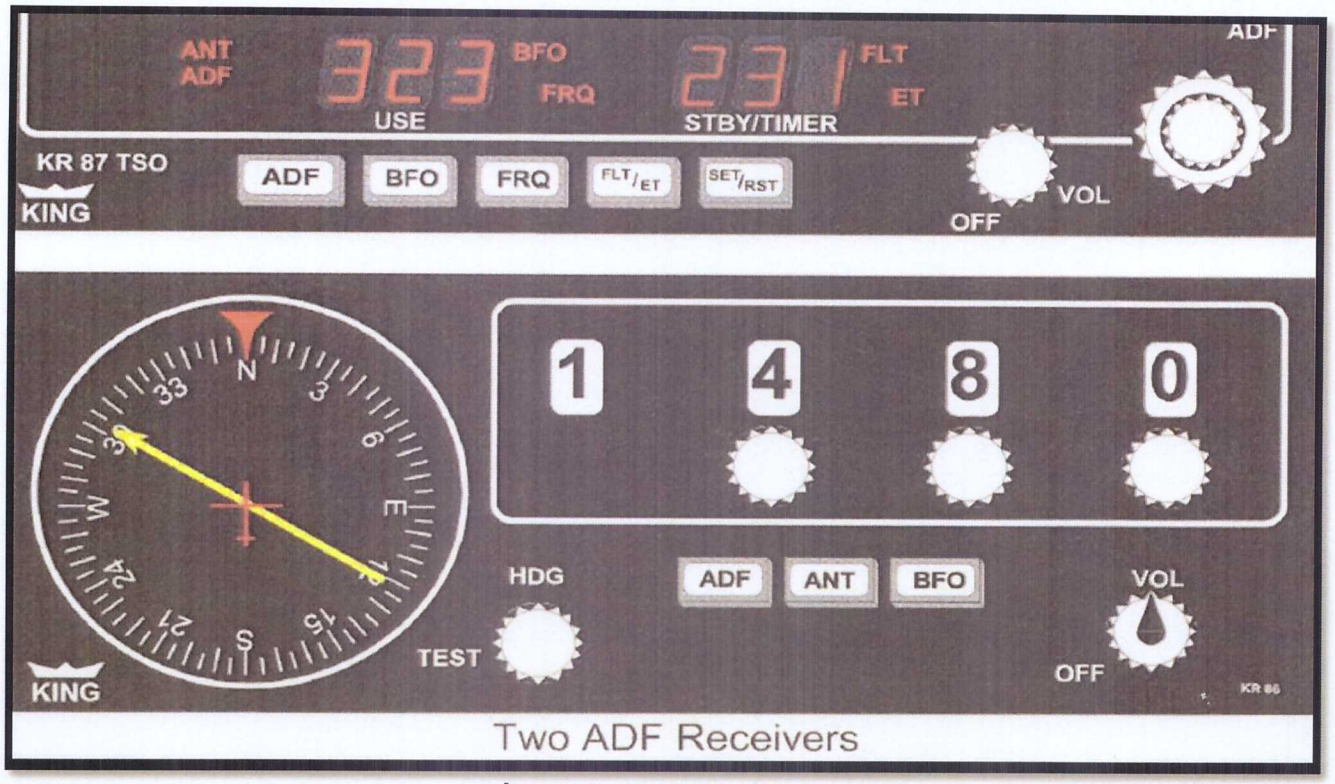
Non directional radio beacon (N.D.B) -

- NDB is a ground based transmitter which transmits signals in all directions , and, the pilot of an aircraft with an automatic direction finder (ADF) in the aircraft can determine his bearing and " home on the station (homing)`` .

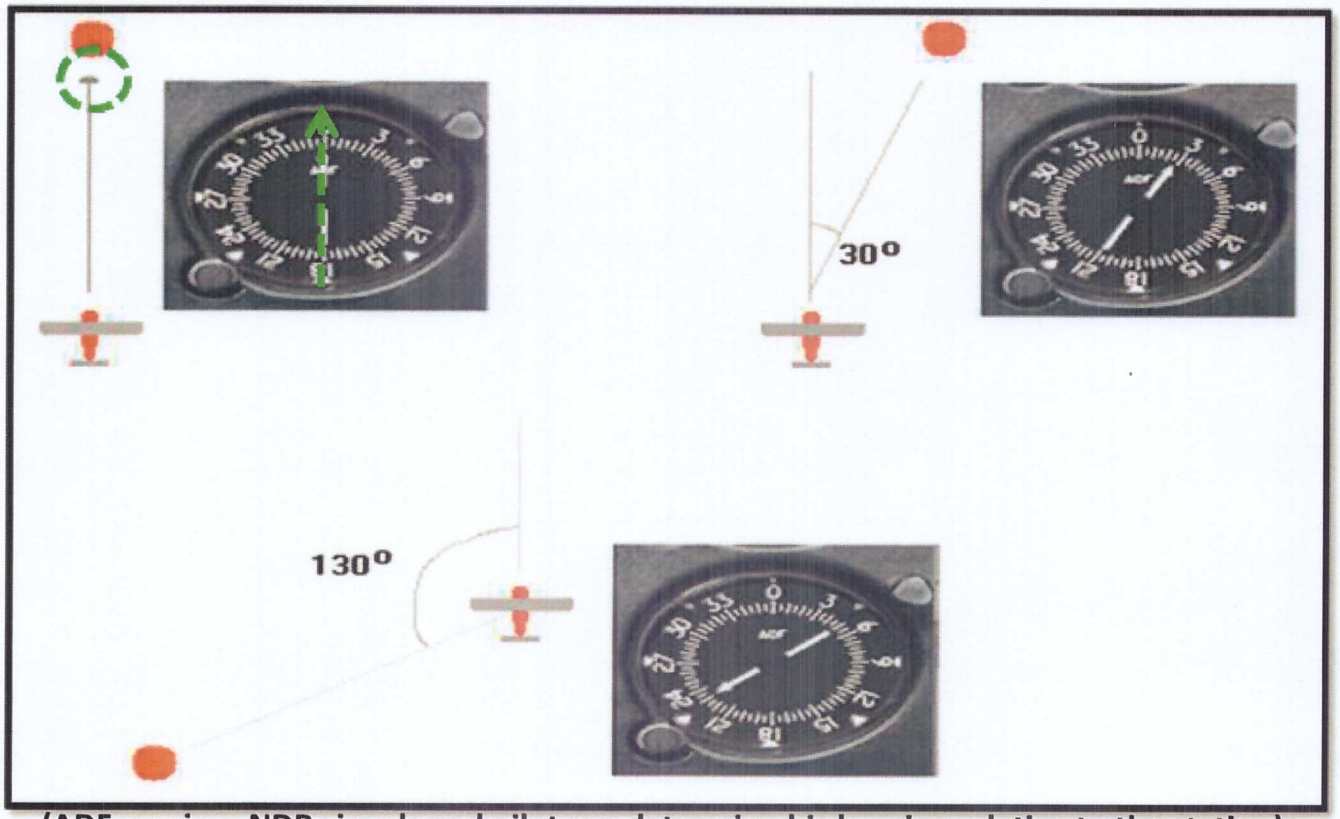
ADF indicators-

ADF indicators in the cockpit consist of :

1) Relative Bearing Indicator (R.B.I) 2) Radio Magnetic Indicator (R.M.I)



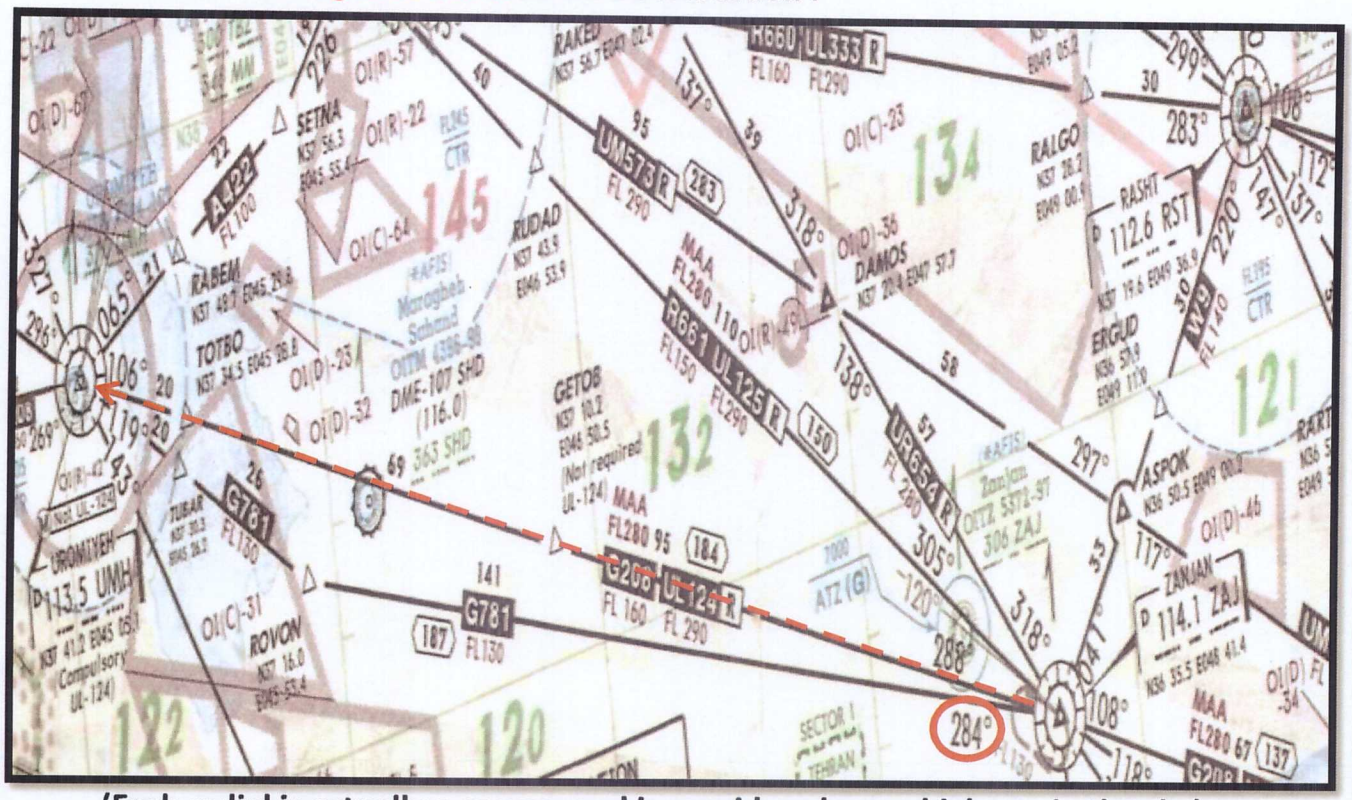
(ADF receiver in the cockpit)



(ADF receives NDB signals and pilot can determine his bearing relative to the station)

Very High Frequency Omnidirectional Range (VOR) –

- The VOR produces 360 degrees radials/tracks at one degree spacing which are aligned in relation to magnetic north at the VOR location .



(Each radial is actually a course, and is considered as an highway in the sky)

VOR control panel and receiver in the cockpit

Basic VOR Indicator Components :

The course selector –

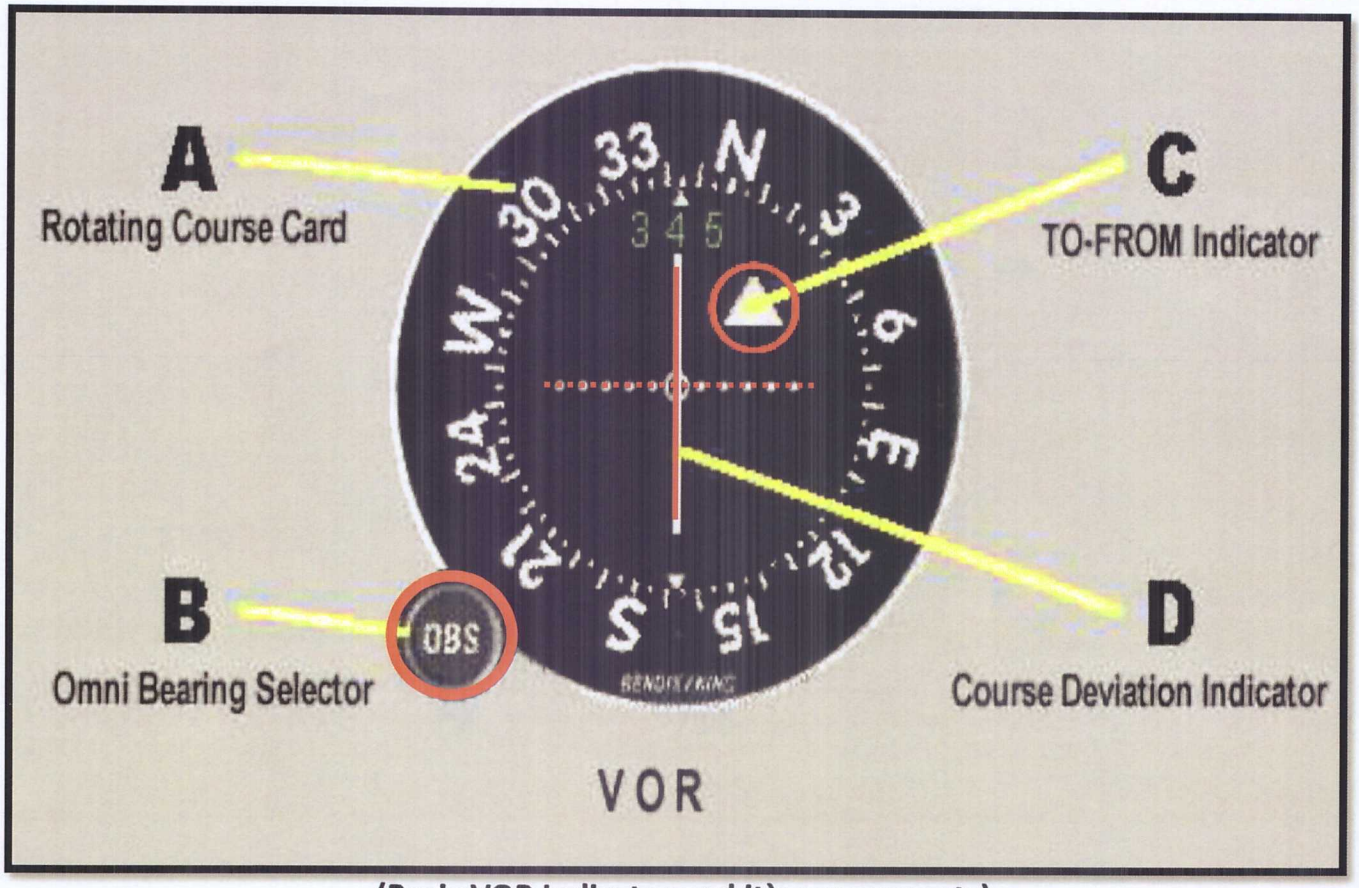
- Also called Omni Bearing Selector (O.B.S) allows the pilot to choose a particular radial by setting it under the course index .

The Course Deviation Indicator (C.D.I) –

- Needle shows whether you are on course or off course . the dots indicate a course deviation of 2° per dot .

The To/From indicator -

- Indicates the pilot if the selected course will bring the aircraft TO or FROM the station .



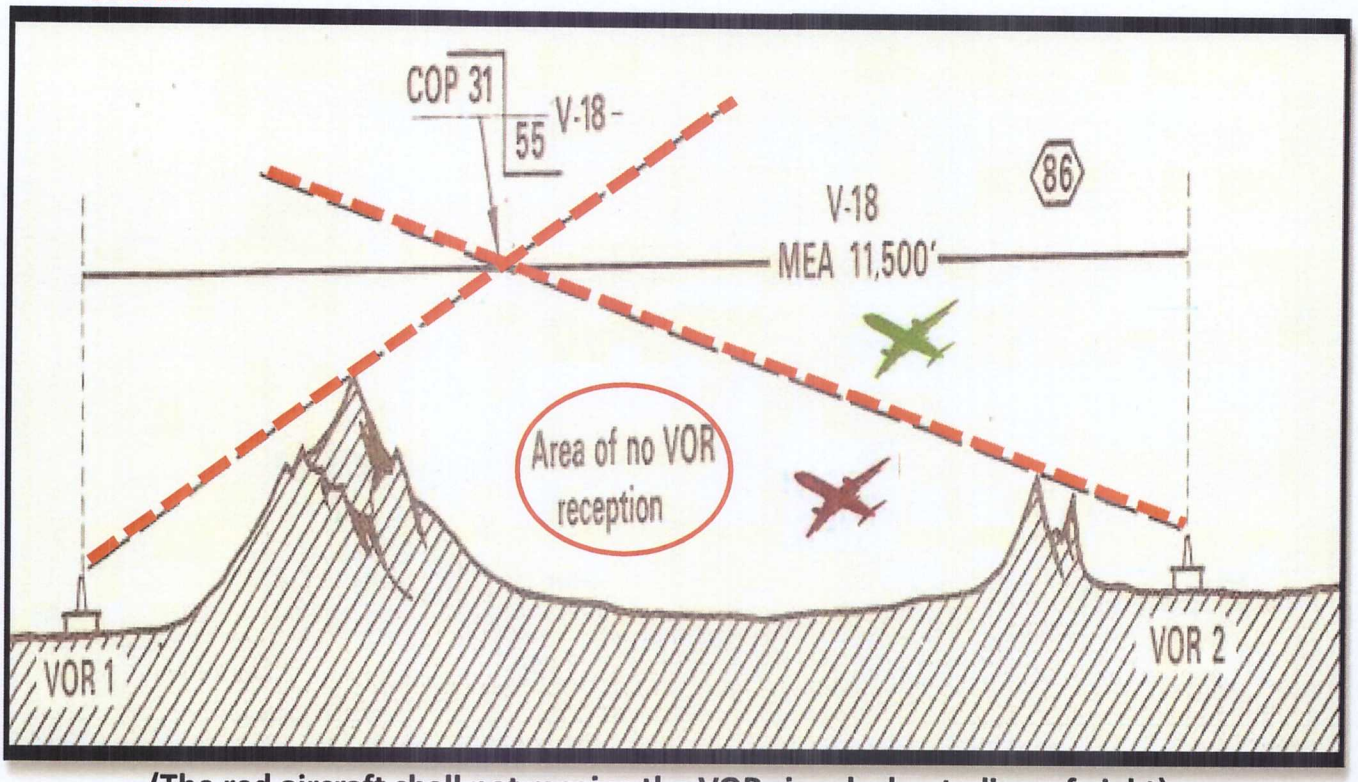
(Basic VOR Indicator and it`s components)

Radio Magnetic Indicator (R.M.I) -

- The R.M.I combines the heading indicator with two bearing pointers, one functions like an ADF bearing indicator, while the other points to VOR stations .

Line of sight –

- VOR signals are transmitted on a line-of-sight basis and any obstacles like mountains, buildings, terrain features, ... block VOR signals and restrict the reception by the aircraft .

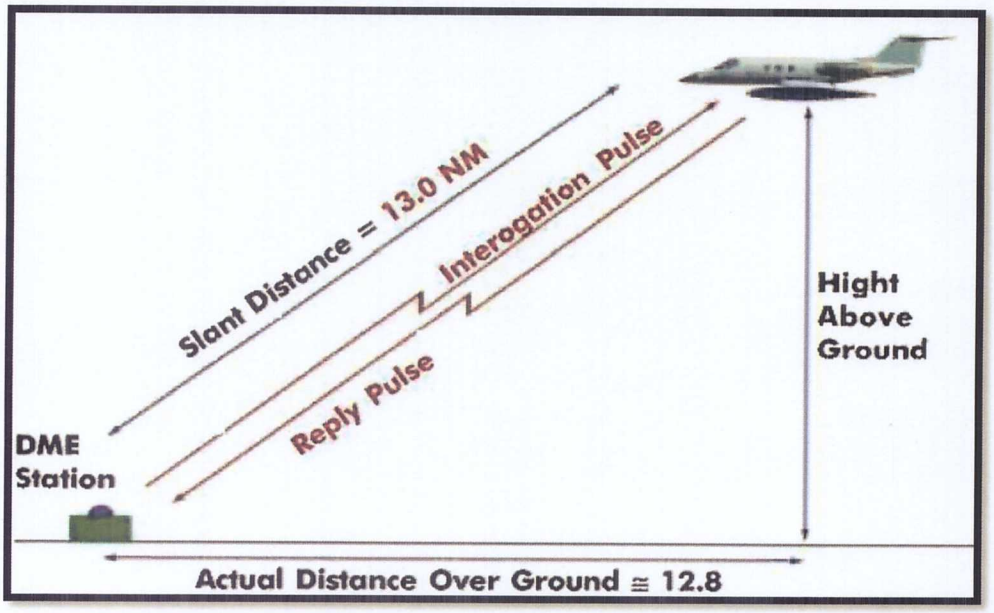


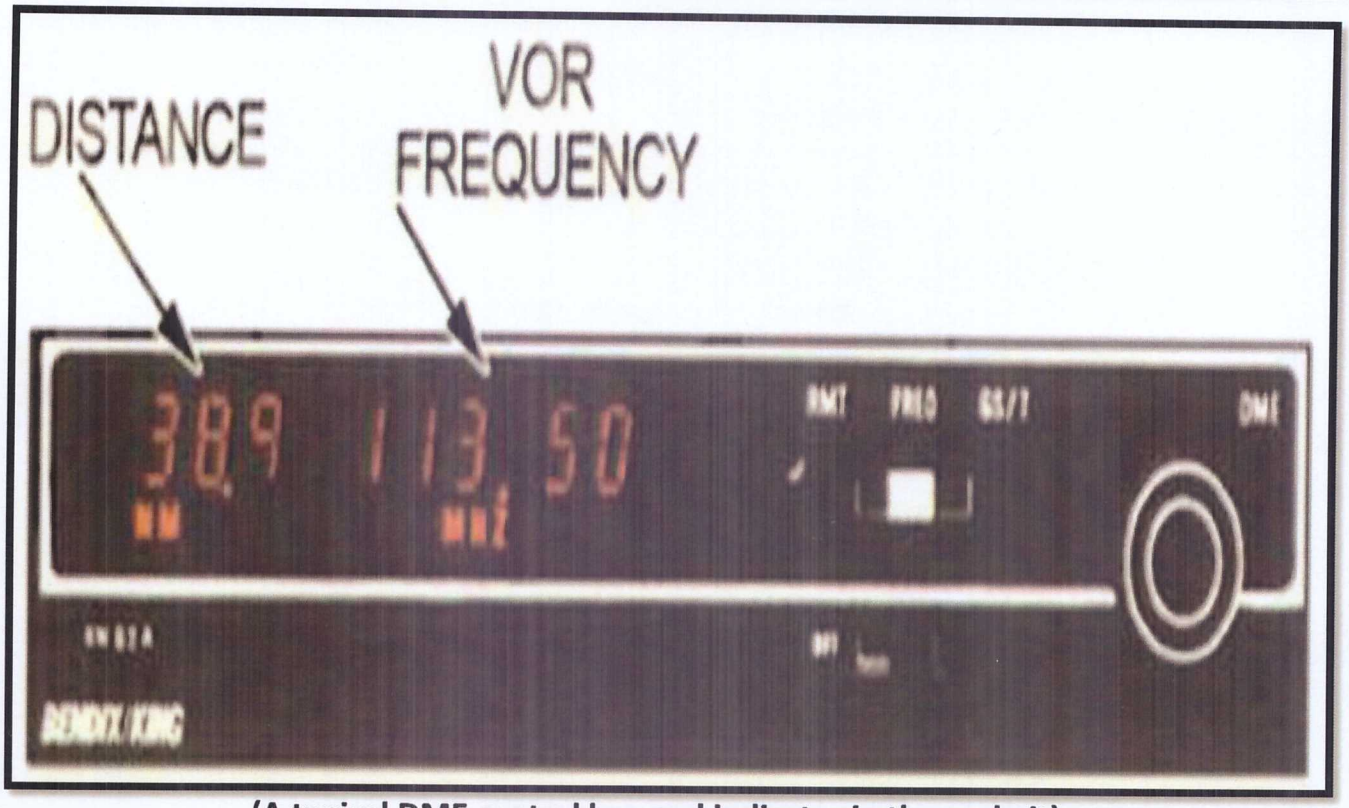
(The red aircraft shall not receive the VOR signals due to line-of-sight)

Distance Measuring Equipment(DME) -

- This facility provides pilot with distance reading in nautical miles from a station .

Airplane DME equipment indicates slant range in N.M





(A typical DME control box and indicator in the cockpit)

VOR/DME -

- VOR/DME refers to combined radio navigation station for aircraft, which consists of two radio beacons, placed together, a VOR and DME .

- VOR produces an angle between the station and the receiver in the aircraft, while DME does the same for distance or range .

Tactical Air Navigation System (TACAN) -

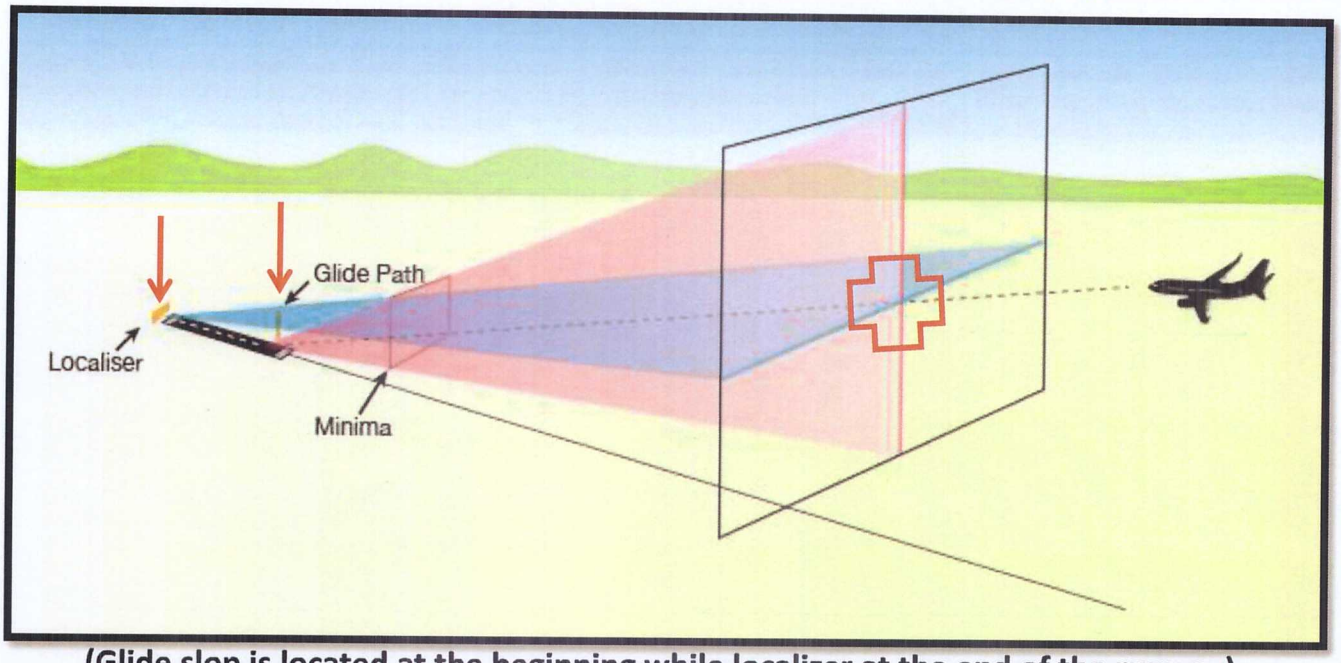
- TACAN, is a navigation system used by military aircraft , which provides the user with azimuth and distance (slant-range) .

VORTAC -

- Is a navigational aid for aircraft pilots consisting of a co-located VOR and a TACAN, which provides pilots with azimuth and distance .

Instrument Landing System (ILS) -

- Is defined as a precision runway approach aid based on two radio beams which provide pilots with both vertical and horizontal guidance during an approach to land .



(Glide slop is located at the beginning while localizer at the end of the runway)

Horizontal Situation Indicator (HSI) -

- HSI which combines the functions of the heading indicator, VOR indicator, DME , glide slope and course information, used by the pilots during the ILS .

H.S.I indicates the position of aircraft in relation to runway centerline and desired glide slope in the cockpit

Precision Approach Path Indicator (PAPI) -

- Is a visual aid that provides guidance information to help a pilot to maintain the correct approach in the vertical path to a runway .

- It is generally located beside the runway approximately 300 meters beyond the landing threshold of the runway .

Precision Approach Path Indicator (PAPI) -

- Is a visual aid that provides guidance information to help a pilot to maintain the correct approach in the vertical plane to a runway .

- It is generally located beside the runway approximately 300 meters beyond the landing threshold of the runway .

(PAPI is normally located at the left side of the runway)

Standard instrument departure (SID) –

- A designated IFR departure route linking the aerodrome or runway with a point , which the en-route phase of the flight commences .

Airway –

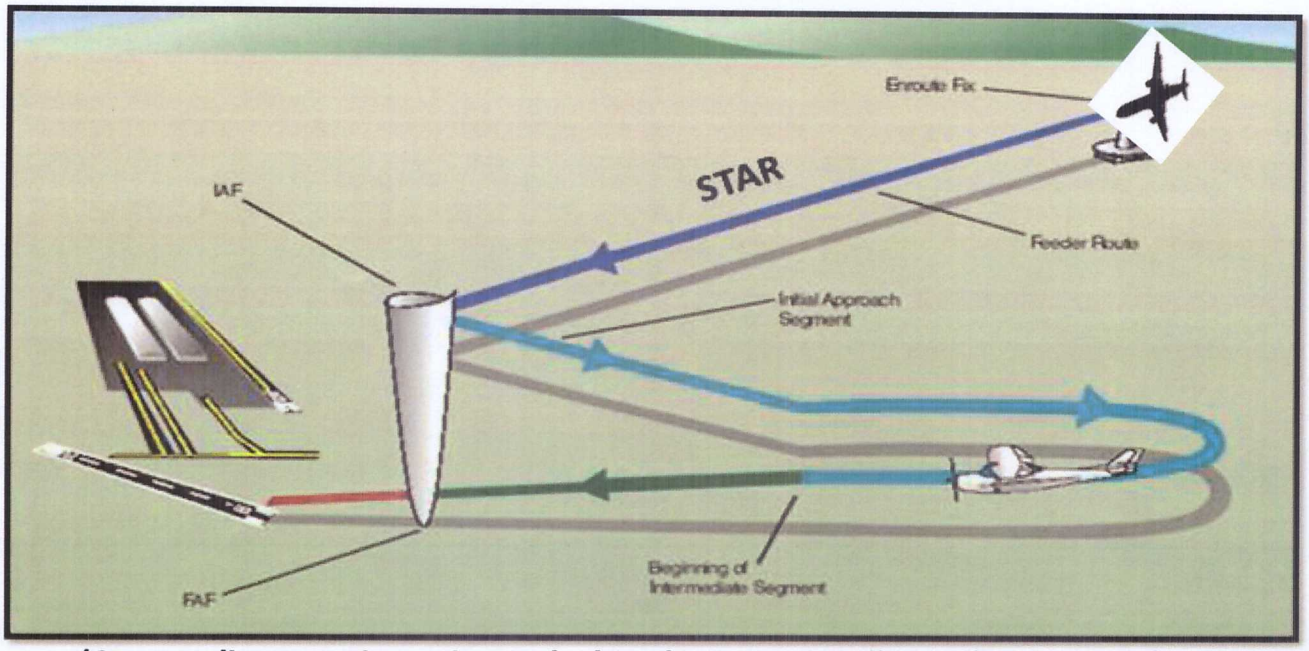
- A control area in the form of a corridor equipped with radio navigation aids (VOR or NDB) .

Standard instrument arrival (STAR) –

- A designated IFR arrival route linking a significant point on an airway, with a point from which a published IAF .

Instrument approach procedure (I.A.P) –

- A series of predetermined maneuvers (five separate segments) by reference to flight instruments , with specified protection from obstacles, from en-route structure to missed approach point, and thereafter, to a holding or alternate.



(Course, distance, time, airspeed, altitude,.....are all specified in I.A.Ps)

Missed approach point (M.A.P) -

- That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated .

Missed approach procedure –

- The procedure to be followed if the approach cannot be continued .

interception –

- Interception is defined as flying from one radial (bearing) to another and, remain on that as long as required .

Compulsory reporting point –

- Reporting points which must be reported to ATC . they are designated on aeronautical charts by solid triangles .

Transponder -

- A transponder is an electronic device that produces a response when it receives a radar-frequency interrogation.

- Aircraft have transponders to assist in identifying them on air traffic control radar; and collision avoidance systems have been developed to use transponder transmissions as a means of detecting aircraft at risk of collision with each other .

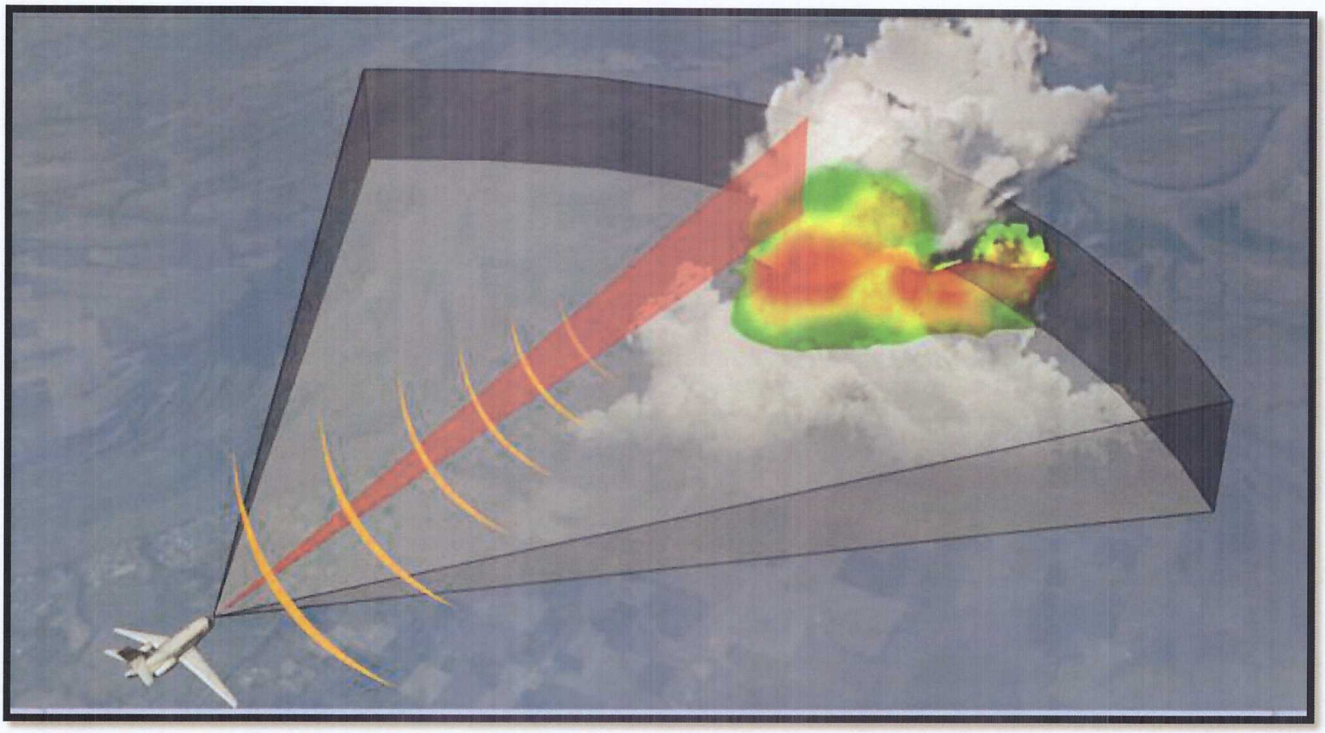
RADAR (Radio Detection and Range) –

- Radar uses pulses of microwave energy to determine the azimuth and distance of the aircraft from the radar station .

Special standard codes :

The pilot should use the following codes, when:

A) Hijacked, code 7500; B) Radio failure, code 7600; and C) Emergency, code 7700



(Weather radar is used in the aircraft to determine and divert around CB clouds)

Azimuth –

- Azimuth is the direction or angle between the radar site or NAVAIDs and the aircraft, which is measured clockwise from north .

Maps and charts –

- Chart is a small scale representation of the surface of the earth on a plan surface .

Longitude –

- Meridians or longitudes , are imaginary lines which extend from the north to the south pole .
- The prime meridian, which passes through Greenwich, England, is labeled of 0 degree of longitude .
- There are a total of 360 degrees of longitude around the earth, with 180° on the east and 180° on the west side of the prime meridian .

Coordinated universal time (UTC) –

- UTC is an international, 24-hour clock used in aviation which is actually the time at the 0 degree longitude which passes through Greenwich, England .

Chart legend –

- The chart legend supplies an extensive information to help the pilot to understand chart symbols .:

Pilotage –

- Pilotage is a visual means of navigation, maintaining an accurate orientation between your intended and actual routes of flight .

Latitude :

- Latitudes are imaginary lines measured angular from the equator 90° north, and 90° south . latitudes are parallel to the equator .

Equator –

- The equator is the imaginary line which circles the earth midway between the north and south poles and is labeled as 0° latitude.
- The distance between latitude also provides a convenient scale for distance measurement, as, one degree of latitude always equals sixty nautical miles and one minute of latitude equals one nautical mile .

Geographical co-ordinates –

- The lines of latitude and longitude are printed on aeronautical charts, with each degree divided into 60 equal minutes .

- By knowing the geographical coordinates (intersection of latitude and longitude), the pilot can locate any position on the earth .

Special use airspaces –

- Airspaces of defined dimensions above the surface of the ground or water wherein the limitations may be imposed upon aircraft operations, and are classified as : Prohibited (P), Restricted (R), Danger (D), and Caution (C) .

- In prohibited areas, the flight of aircraft is not permitted at any time under any circumstances;

- In restricted areas, the flight of aircraft is restricted to only bad weather conditions and obtained prior permission;

- In danger areas, dangerous for flight of aircraft may exists at specified times; and

- In caution areas, it is necessary for the pilots to use caution when entering such areas .

Course –

- The intended or desired direction of flight measured in degrees from true or magnetic north .

Drift angle –

- Is caused by the *wind effect* on an aircraft and is defined as the angle between the aircraft course and the aircraft track .

Track –

- The actual flight path of an aircraft over the ground . the track should be equal to course during flight by applying appropriate wind correction angle .

Wind correction angle (WCA) –

- The angular difference between the heading of the airplane and the course . it is applied to course to determine heading . this method is referred to as crab .

Heading –

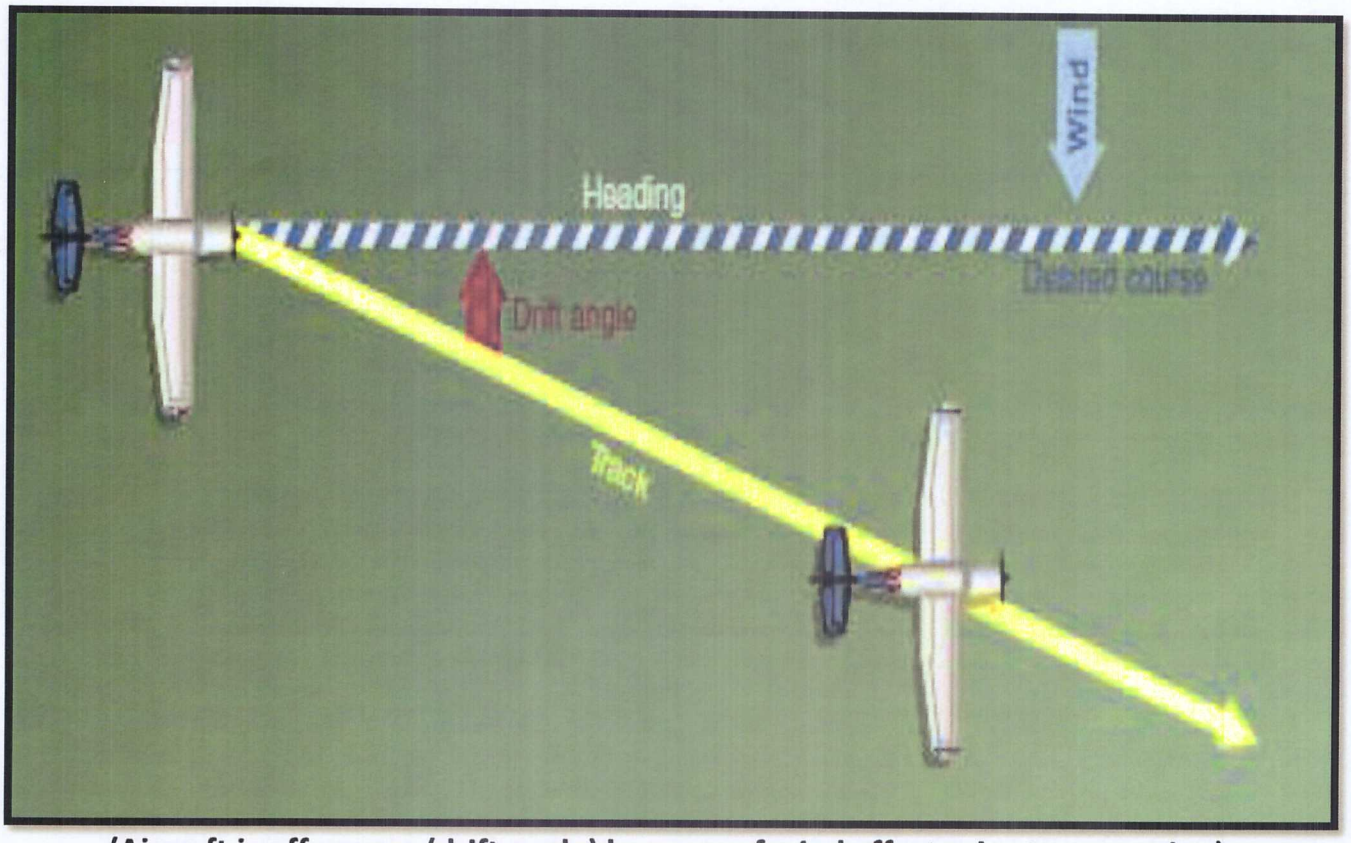
- The direction in which the longitudinal axis of the airplane is pointed with respect to true or magnetic north .

Crab –

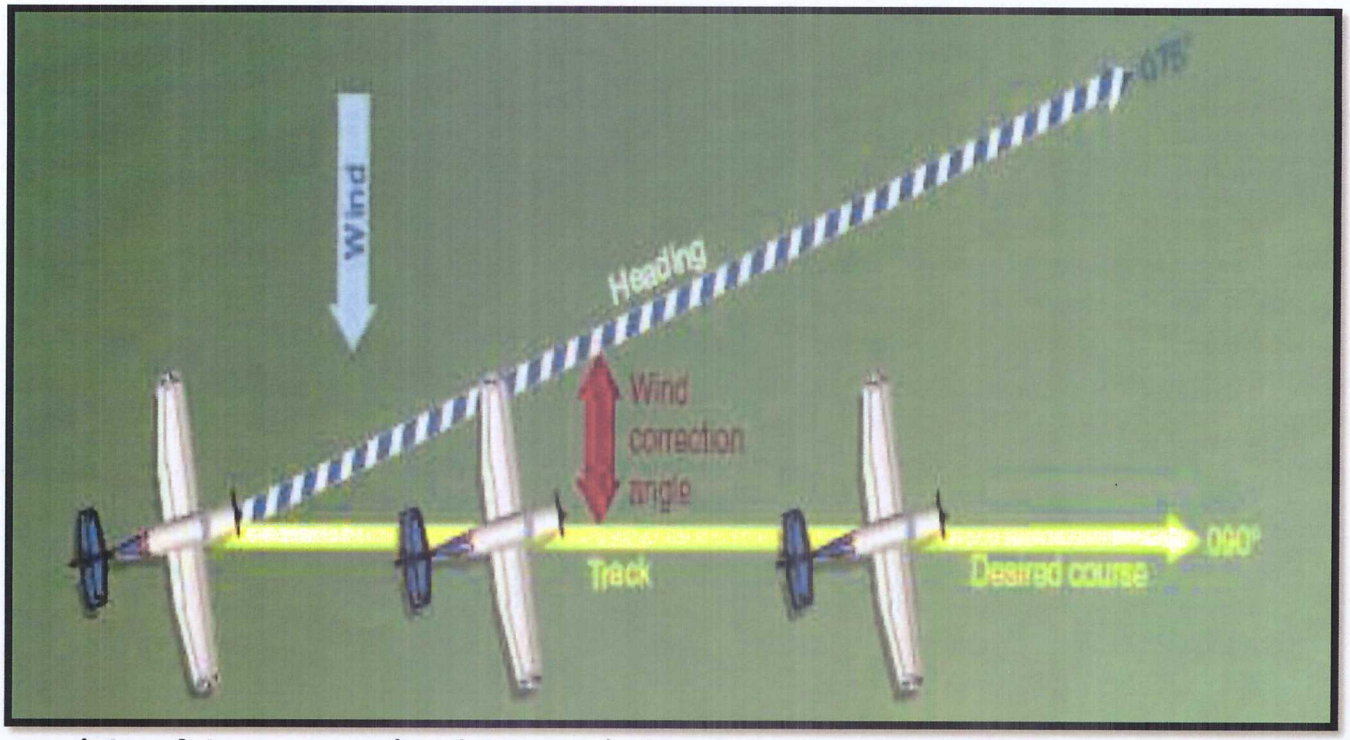
- Crab is a flight condition in which the nose of the airplane is pointed into the wind for a sufficient amount to correct for a crosswind and maintain a desired course over the ground .

- Whenever a pilot flies in wind, the aircraft`s performance is affected, because the wind direction and speed have a direct impact on the aircraft`s direction of flight and ground speed .

- That portion of the wind which causes the airplane to drift off course is called the crosswind component, while the headwind decreases and tailwind increases the airplane`s groundspeed .



(Aircraft is off-course (drift angle) because of wind effect prior to correction)



(Aircraft is on-course (track = course) after correction which is known as ``crab``)

Lights to be displayed by aircraft –

Anti-collision lights –

- Two red lights, one on top and one under the fuselage, are intended to attract attention and will be displayed :

1) From sunset to sunrise ;

2) Operating on the movement area ; and

3) On the movement area when engines are running

Navigation lights –

- Two green and red lights, green light is mounted on the right (starboard) wingtip and the red light is mounted on the left (port) wingtip, and are intended to indicate the relative path of the airplane and its extremities and will be displayed :

1) From sunset to sunrise ; and

2) Moving on the movement area

(Anti-collision lights, red, and, Navigation Lights, green and red as shown above)

Meteorology –

WEATHER CONDITIONS TAKE ON NEW MEANING WHEN YOU, AS A PILOT, FLY ABOVE THE EARTH IN ATMOSPHERE .

Atmospheric layers :

1) Troposphere –

- Is the one closest to the earth, extending from the surface to an average altitude of about six or seven miles .

2) Tropopause –

- Is a thin layer of the atmosphere at the top of the troposphere which acts like a lid, and in turn, keeps most of the weather phenomenon below the tropopause .

3) Above the tropopause, is the stratosphere, mesosphere, and the thermosphere .

Atmospheric circulation –

- The uneven heating of the earth`s surface causes variation in air temperature, density and pressure .

- This in turn, causes the warm air rises and is replaced by cooler air, because the warm air is less dense and lighter than the cool air .

- The atmosphere also contains some water vapor, but the amount can vary from almost zero to about five percent by volume .

This relatively small amount of water vapor is responsible for major changes in the weather conditions .

Moisture/ humidity –

- Weather is very dependent upon the moisture content of the air. If the air is dry, the weather usually will be good, and if, the air is very moist, poor or even severe weather can occur .The amount of moisture in the air depends on air temperature .

Relative humidity –

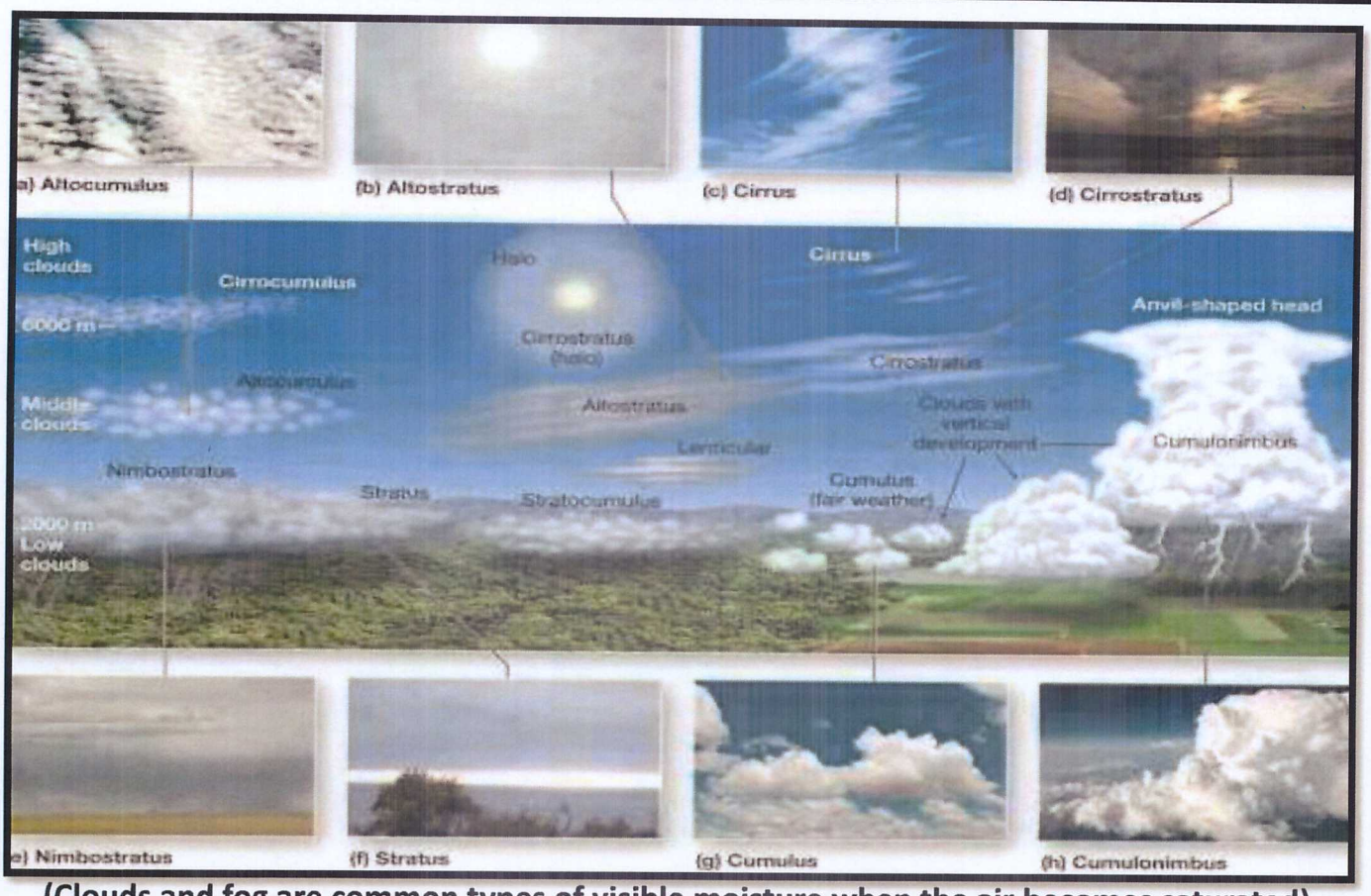
- Relative humidity is the actual amount of moisture in the air compared to the total amount that can be present at that temperature , as the temperature decreases, the relative humidity increases .

Dew point –

- Dew point is the temperature at which air reaches a state where it can hold no more water . when the dew point is reached, the air contains 100% of the moisture it can hold at that , and it is said that the air is saturated .

Visible moisture –

- As the air cools to its saturation point, the processes of condensation and change invisible water vapor into states that are readily seen . most commonly, this visible moisture takes the form of clouds or fog .



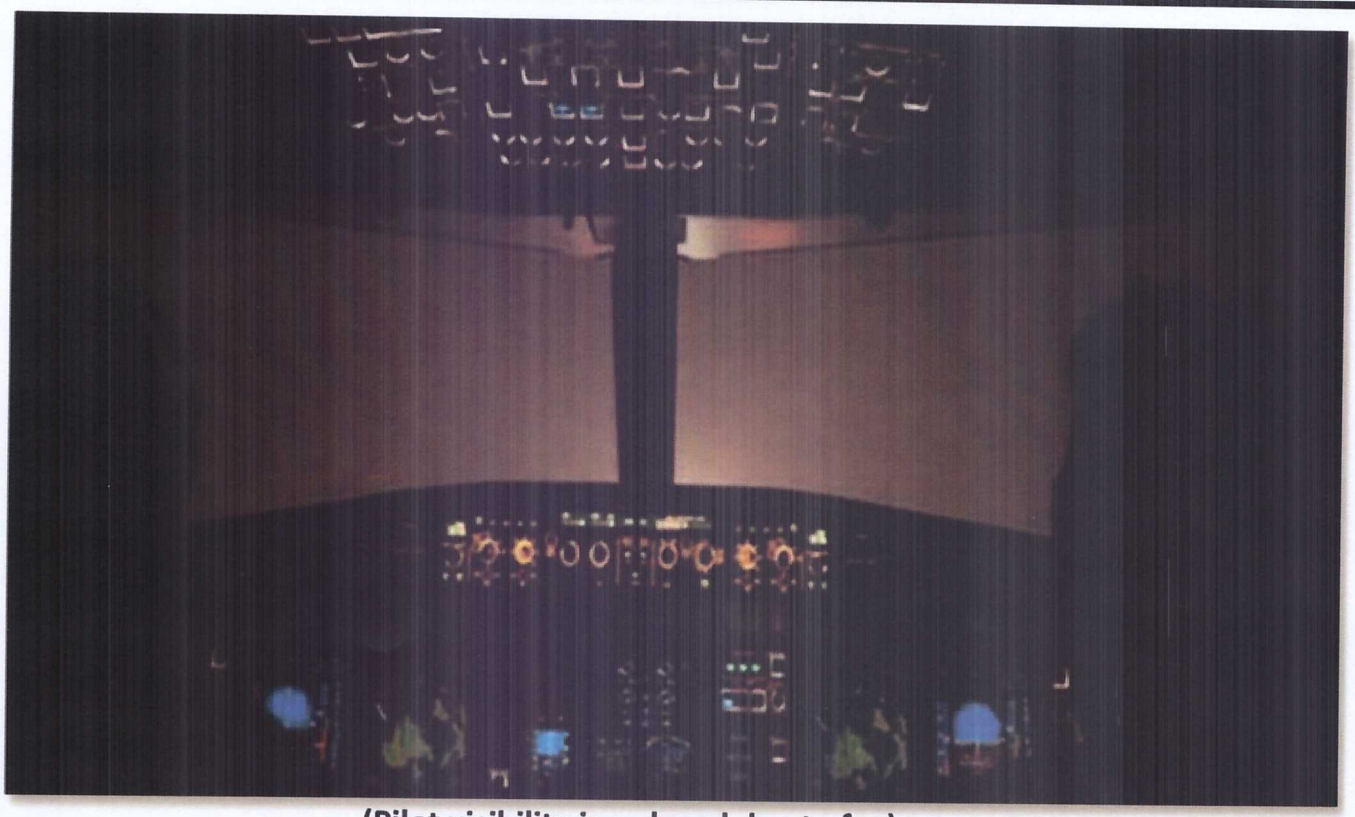
(Clouds and fog are common types of visible moisture when the air becomes saturated)

- **NOTE- When clouds form near the surface, they are referred to as fog .**

Fog -

- **Fog is a surface based cloud (below 50 feet) which is the most frequent cause of decreasing surface visibility and is one of the most common weather hazards in aviation specially during takeoff and landing .**

- **An small and decreasing of temperature/ dew point spread (2˚C and decreasing), indicates conditions are favorable for the formation of fog and low clouds .**



(Pilot visibility is reduced due to fog)

Precipitation –

- Drizzle, rain, snow, hail, ice pellets, and ice crystals are all forms of precipitation, which occur when the particles of moisture in a cloud grow to a size where the atmosphere can no longer support their weight and they fall from the atmosphere .

Temperature laps rate –

- When air rises in to the atmosphere, the temperature and pressure decreases .

- The rate at which the temperature decreases with an increase in altitude is referred as its laps rate, which the average rate of change is 2˚C per 1,000 feet up to 36,000 feet and is considered constant up to 80,000 feet .

Temperature inversion –

- When temperature increases with an increase in altitude, a temperature inversion exists .

- It is important to know what type of cloud you are flying into. Some clouds may have more turbulence than others. Some clouds may have more chance of icing than others.

Types of clouds –

- Clouds can be divided into three main categories based upon the Latin words which refer to the process of formation and physical structure of the clouds .

1) Cirrus clouds –

- Which is in the high altitude range and occurs mostly in the form of filaments.

2) Stratus clouds -

- They are mostly sheet-like in structure which forms in stable air; and

3) Cumulus clouds –

- That appear heaped, rolled, and/or rippled mostly formed in unstable air .

Clouds are classified according to their height above and appearance from the ground .

1) Low-level clouds :

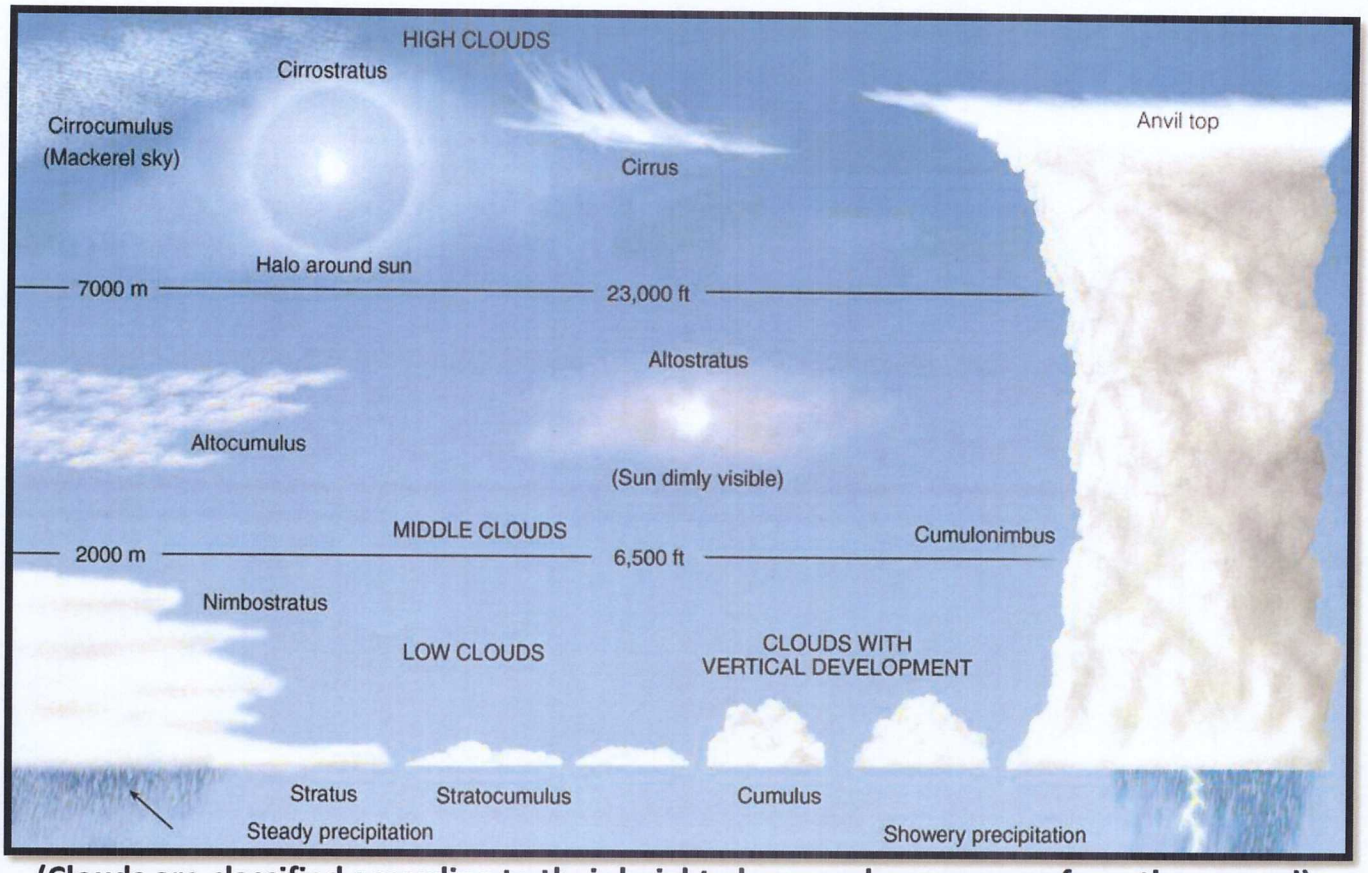
- Low clouds occur below 6,500 feet, and The three main types of low clouds include stratus, which develop horizontally, cumulus and stratocumulus , which develop vertically .

Mid-level clouds :

- Mid-level clouds appear between 6,500 and 23,000 feet, and The two main type of mid-level clouds are altostratus and altocumulus .

High-level clouds :

- High-level clouds occur above about 23,000 feet and are given the prefix "cirro-", and three main types of high-level clouds are cirrus, cirrostratus and cirrocumulus .



(Clouds are classified according to their height above and appearance from the ground)

Contrail –

- **Contrail, short form of ``condensation trail``, are long-thin-artificial clouds that sometimes form behind the aircraft, by the water vapor in the exhaust of engines in the form of suspension of billions of liquid droplets or ice crystals usually occur above 26,000 feet .**

Air masses –

- **An air mass is a large body of air with fairly uniform temperature, pressure and moisture content , with several hundred thousands of miles across, which are classified as polar or tropical according to the source of the regions where they originate .**

Front –

- **The boundary between air masses is called a front .**

Types of fronts –

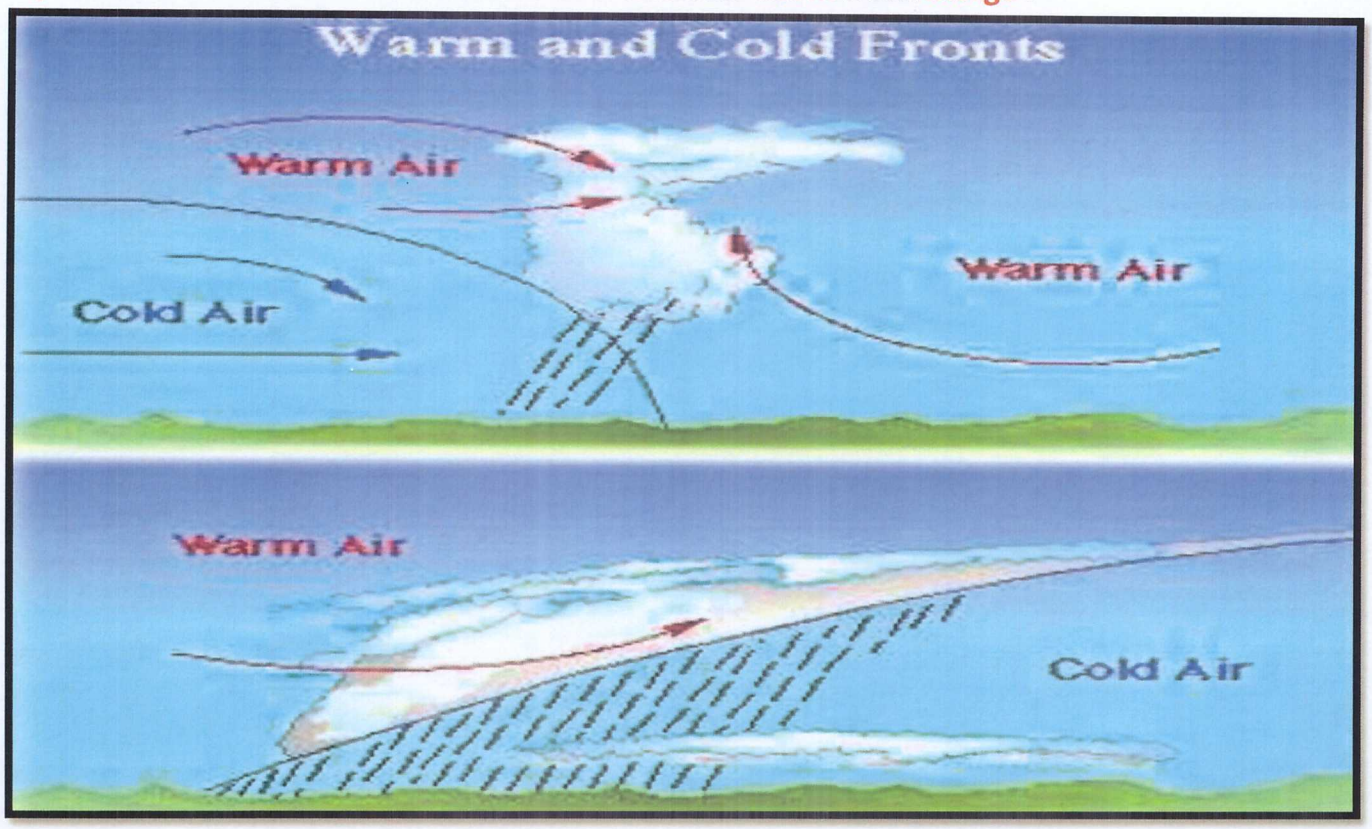
- **Fronts are named according to the temperature of the advancing air relative to the temperature of the air it is replacing :**

1) **cold front** – Is a front where cool air is moving to displace warmer air .

2) **warm front** – Is a front where warm air is replacing cold air .

3) **stationary front** – Is a front that has no movement .

4) **occluded front** – Is a front where cold and warm front merge .



(Cold front (top),and, warm front (below), are replacing each other

Squall line –

- Squall line is a narrow band of active thunderstorm which normally contains the most sever types of weather hazards may be several hundred miles long and vary in width from 30 to 50 miles .

Towering Cumulus (TCU) -

- A large cumulus cloud with great vertical development, usually with a cauliflower-like appearance .

Anvil –

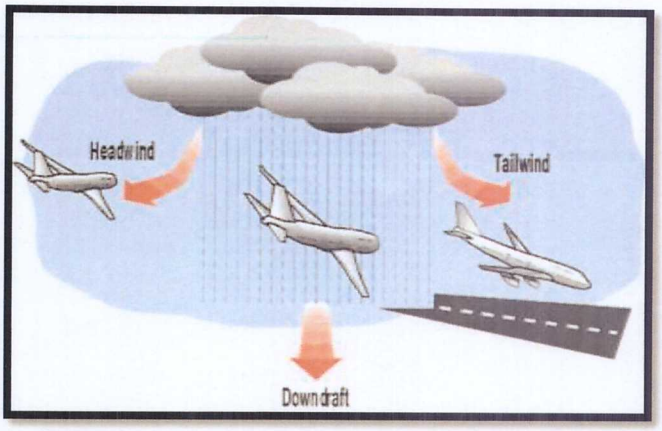
- During dissipating stage, the upper level winds often below the top of the cloud downwind, creating the anvil shape .

Wind shear –

- Wind shear is a sudden shift in wind speed or direction that may occur at any altitude in a relatively short distance .

Microbursts –

- A microburst is an intense, localized downdraft which spreads out in all directions when it reaches the surface within 100 feet, covering less than two and a half miles at the surface, and wind speed as high as 150 knots which creates danger to aircraft landing, but it only lasts two to five minutes .



(Wind shear (Left), and, Microbursts (Right), are of the most dangerous when landing)

Turbulence -

- Is caused by the movement of disturbed air through which an aircraft is flying that moment and causes slight, erratic changes in altitude and/or attitude (pitch, roll, yaw). it may occur either within clouds or clear of clouds .

Clear Air Turbulence (CAT) -

- Is the turbulent movement of air masses in the absence of any visual clouds, and is caused when bodies of air moving at widely different speeds meet .

Icing –

- Icing on airplane structure can occur during flight in areas of visible moisture when the temperature of the airplane surface is 0°C or colder, causing a loss of lift, an increase in airplane weight, and control problems .

To overcome icing conditions, the airplanes are equipped with two systems :

1) Anti- icing : Anti-icing equipment is provided to prevent ice from forming on certain protected surfaces on the airplane; and

2) De-icing : De-icing equipment is provided to remove ice that has already formed on protected surfaces of airplane .

Ceiling -

- Ceiling is the AGL altitude of the lowest layer of clouds that is below 20,000 feet, covering more than half the sky reported as broken or overcast .

The amount of clouds are reported as :

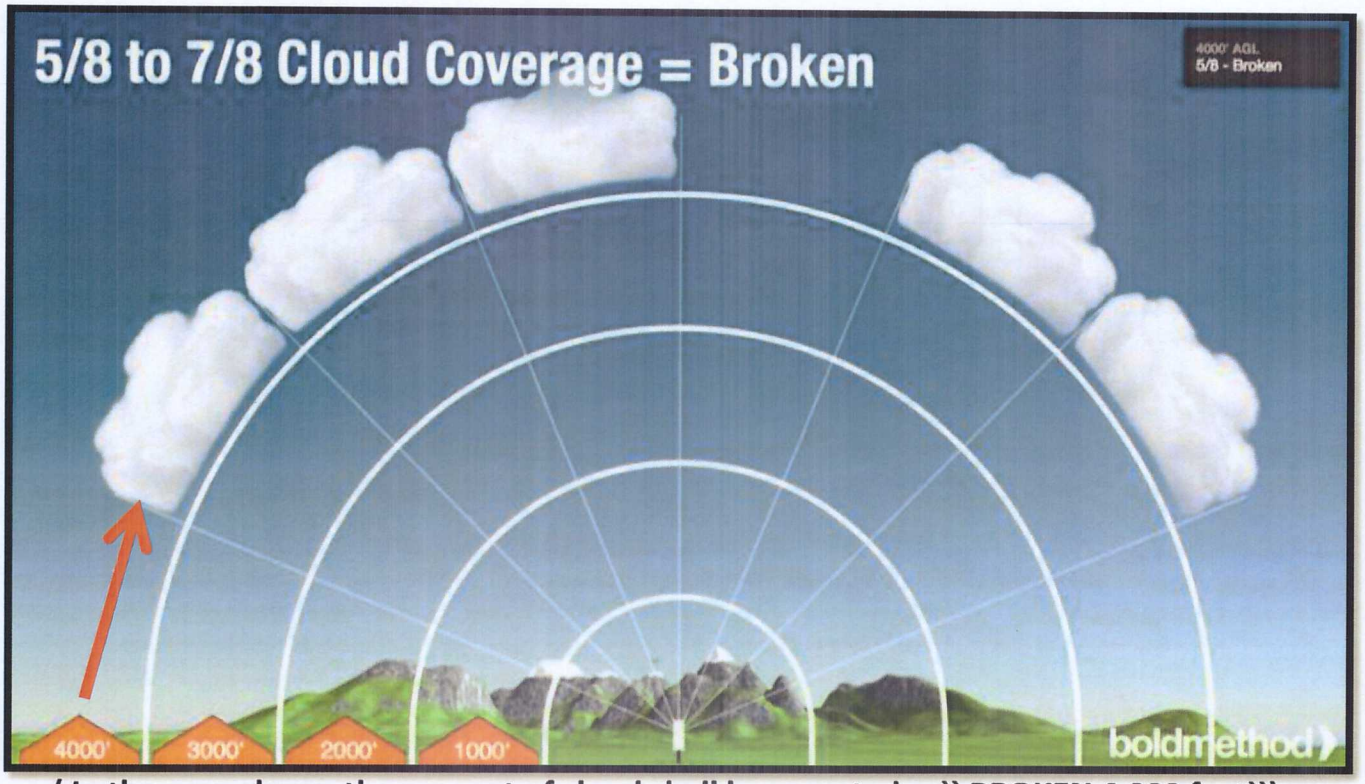
1) Sky clear (SKC), 0 oktas: 0/8ths

2) Few (FEW), 1 to 2 oktas (1/8 to 2/8)

3) Scattered (SCT), 3 to 4 oktas (3/8 to 4/8)

4) Broken (BKN), 5 to 7 oktas (5/8 to 7/8)

5) Overcast (OVC), 8 oktas (8/8)



(In the case above, the amount of cloud shall be reported as`` BROKEN 4,000 feet``)

Visibility -

- Visibility is the greatest distance an observer can see and identify objects through at least 180 degrees of the horizon .

SIGMETs –

- Stands for significant meteorology is an in-flight advisory report that includes weather phenomena of severe or extreme turbulences, severe icing, dust storms or sand storms which lowers the visibility .

Pilot reports (PIREPs) –

- PIREPs are another source of valuable weather information . pilots are urged to cooperate and reports of cloud tops, thunderstorms, ice, turbulence, strong winds, and other significant flight condition information .

- Before beginning any flight as pilot-in-command of an aircraft, you are required to familiarize yourself with all available information concerning that flight .

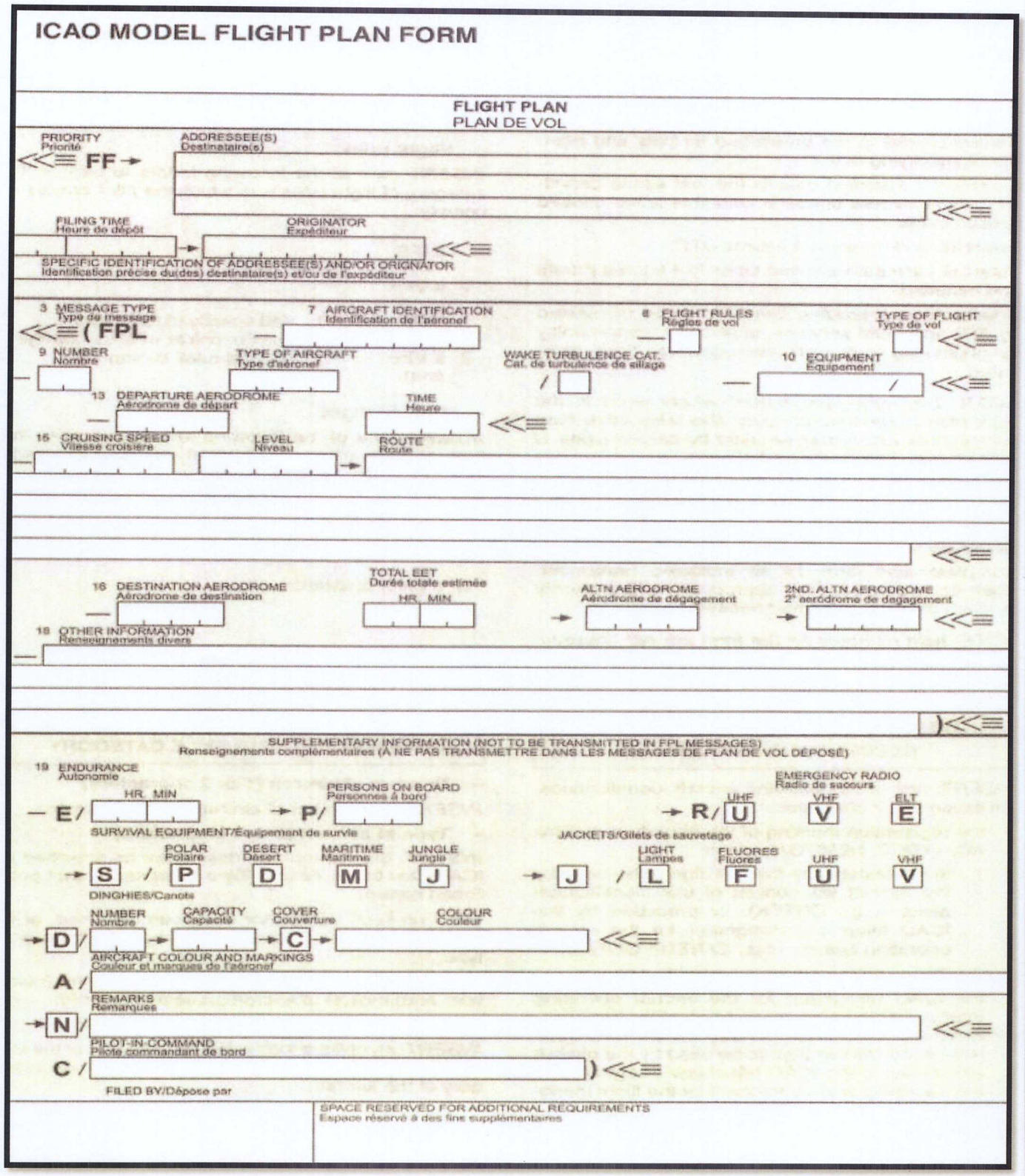
Operator`s flight dispatch -

- They are the main liaison to the cockpit crew, and, authorized by the appropriate authorities or airlines to exercise Operational Control, Flight Planning, and Inflight Assistance .

(Flight dispatch is the heart of an airline)

Flight plan –

- Specified information provided to air traffic service units, relative to an intended flight of an aircraft .



(A flight plan shall be completed and delivered to Air Traffic Service, ATS unit before flight)

VFR flight –

- **A flight conducted in accordance with the visual flight rules .**

IFR flight –

- A flight conducted in accordance with the instrument flight rules .

current/ present weather -

- Is used to compile information concerning existing surface weather at the various observation stations and are reported hourly

Forecasts weather reports –

- A prediction of surface weather expected at an airport is a forecast . it is one of the best sources for the pilots for predicting what the weather will be in the future at a specific airport .

Weight & Balance –

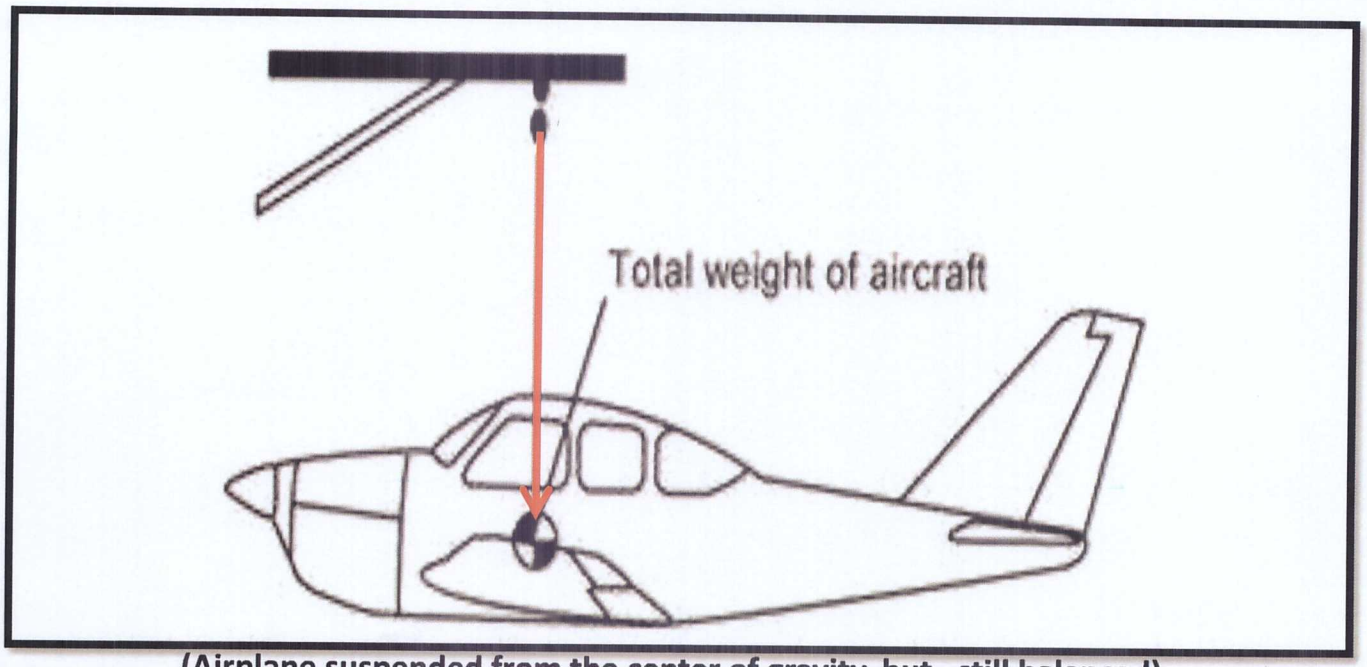
- Weight is the force of flight which gravity attracts a body toward the center of the Earth, and, Balance is the location of the CG of an aircraft, which is a point at which the aircraft would balance if it were suspended at that point .

Weight & balance is very critical to safety of the flight.

- The aircraft is said to be weight and balanced when the gross weight of the aircraft is under the maximum gross weight specified by manufacturer, and, the center of gravity is within limit and will remain in limits for the duration of the flight .

Center of gravity (C.G) –

- Is the theorical point where the entire weight of the airplane is considered to be concentrated, and an airplane would balance if it were possible to suspend it at that point .



(Airplane suspended from the center of gravity, but , still balanced)

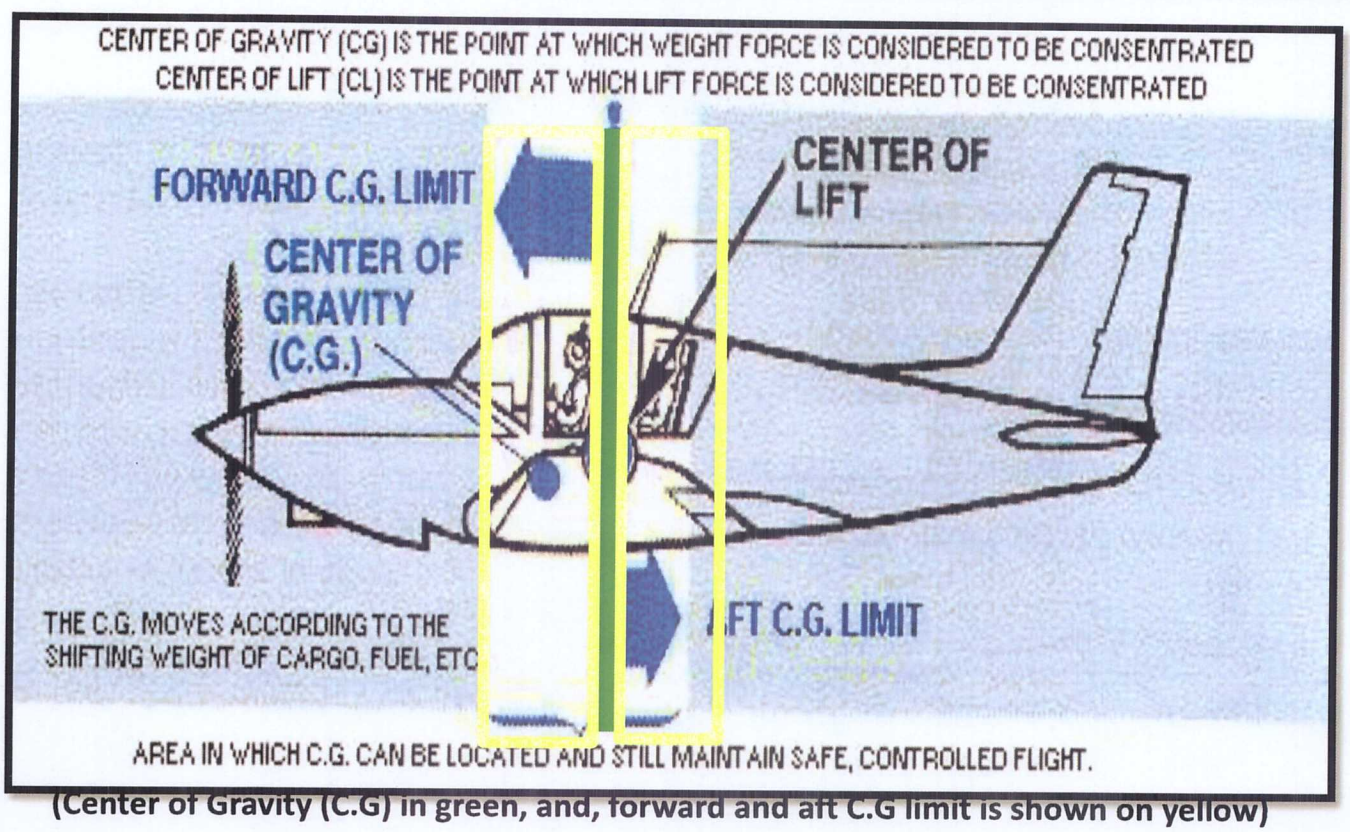
- The CG is not a fixed point as it varies its location depending on how the load is shifted or expended.

C.G range –

- All airplanes have forward and aft limits for the position of the C.G, and, the distance between limits is called the C.G range .

- generally, the longitudinal stability of the aircraft and effective use of elevator control is dependent upon the location of the center of gravity.

- The location of C.G depends on the distribution of the weight in airplane and improper location of C.G causes loose of stability and the maneuverability, so, the pilot must always check weight distribution for airplane balance .



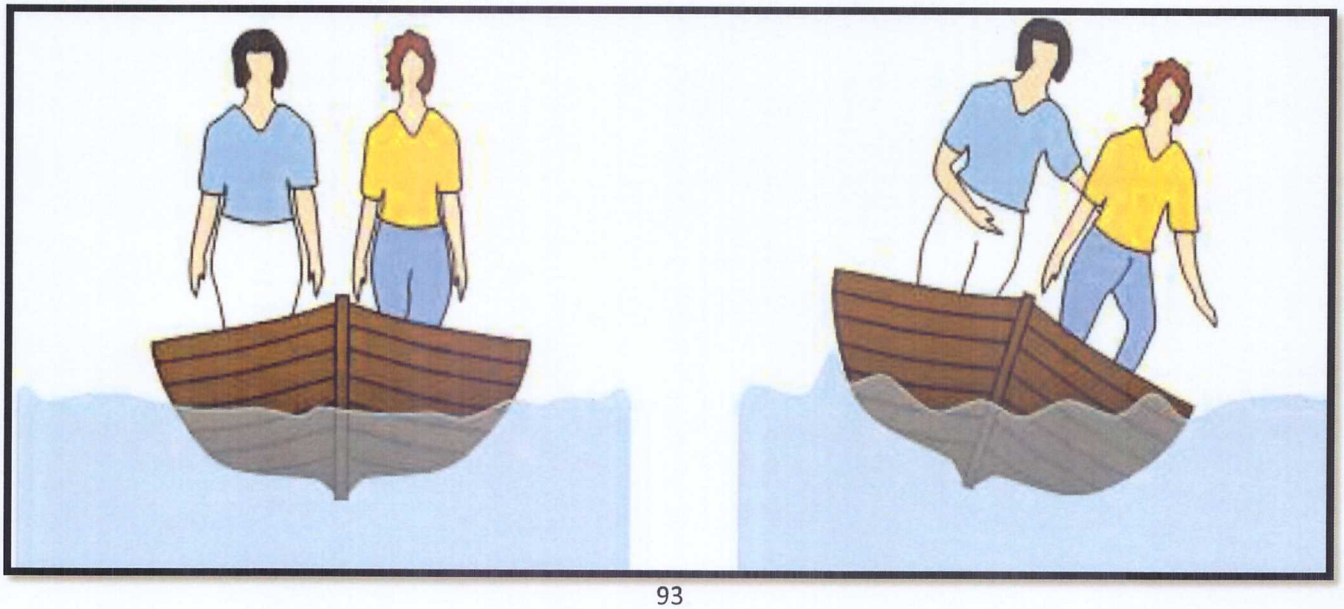
(Center of Gravity (C.G) in green, and, forward and aft C.G limit is shown on yellow)

Stability –

- **Is the primary quality of an airplane to correct for conditions, to return or to continue on the original flight path .**

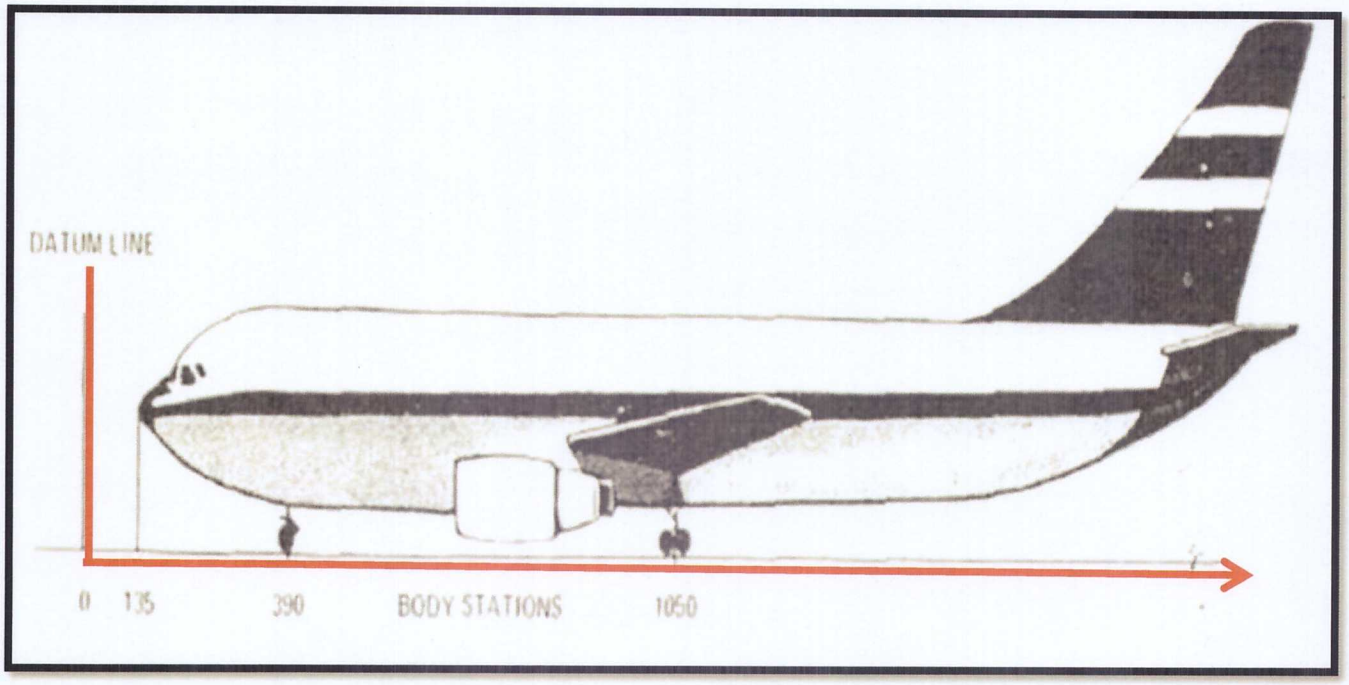
Maneuverability –

- **Ability of an aircraft to change direction along a flight path and the stresses imposed upon it .**



(The resultant of forward C.G airplane)

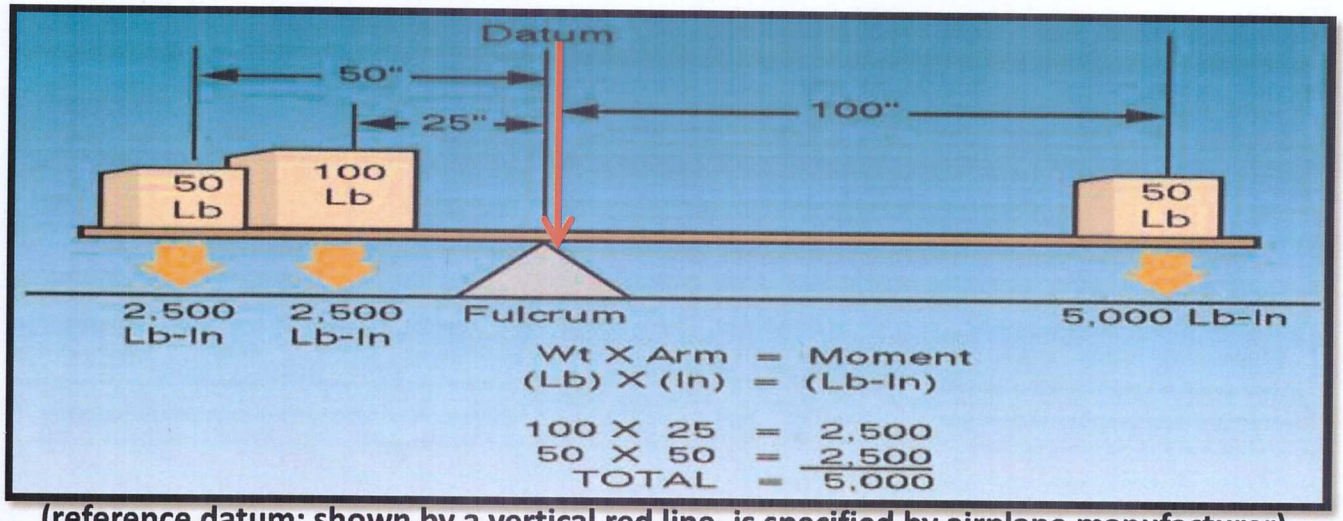
- Balance is determined by the location of the C.G, which is usually described as a given number of inches aft of the reference datum .



- The location of the reference datum is established by the manufacturer and is defined in the POH or in the airplane`s weight and balance papers .

Reference datum –

- is an imaginary vertical plane, fixed somewhere along the longitudinal axis of the airplane, from which all horizontal distances are measured (normally in inch) for weight and balance purposes .



(reference datum; shown by a vertical red line, is specified by airplane manufacturer)

Arm –

- The horizontal distance from the datum to any part of the airplane located within the airplane is called the arm .

Moment –

- If the weight of a load is multiplied by its arm, the result is known as its moment .

The pilot is responsible for the safe loading of the airplane and must ensure that it is not overloaded .

An overloaded airplane will cause serious problems such as:

1) The takeoff run will be longer ;
2) The angle of climb and the rate of climb will be reduced ;
3) Maximum ceiling will be lowered ;
4) The operational range will be shorten ;
5) Landing speed will be higher ;
6) Landing roll will be longer ;
7) Causes structural stress during maneuvering and turbulence that could lead to damage ;

Airplane weight –

Basic empty weight –

- Weight of the standard airplane, optional equipment, unusable fuel, and full operating fluid .

Payload –

- Payload refers to the weight of the flight crew, passengers, and any cargo or baggage .

Zero fuel weight –

- Zero fuel weight is basic empty weight plus payload .

Usable fuel –

- Usable fuel is the fuel available for the flight, while, the unusable fuel, is the quantity of fuel that cannot be safely used during flight

Ramp weight –

- Ramp weight is the zero fuel weight plus usable fuel .

Takeoff weight –

- Takeoff weight is the ramp weight minus the amount of fuel used during start, taxi, and engine run up .

Landing weight –

- Is the takeoff weight minus the fuel used during flight .

NOTE- The maximum allowable weight for an aircraft for various phases of flight operation is determined by the manufacturers after conducting stress analysis, static tests, flight tests .

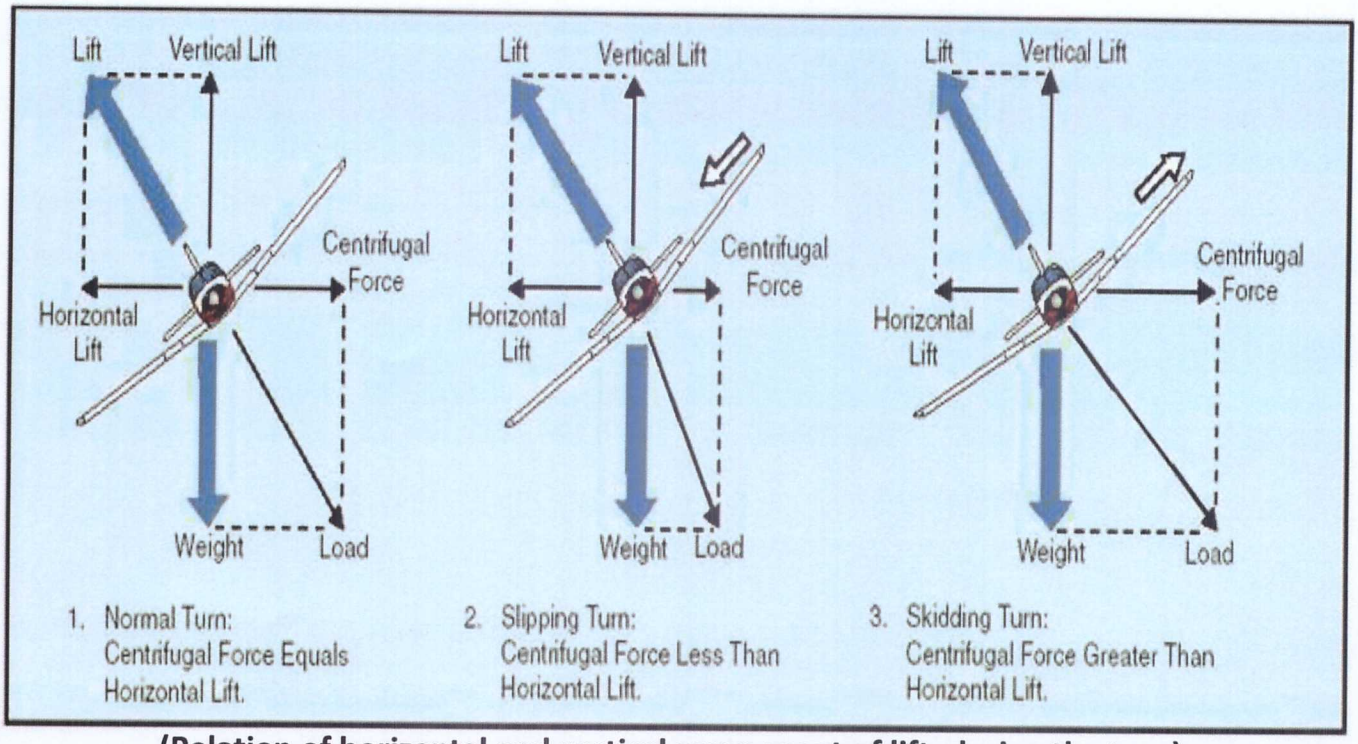
G- load –

- For an aircraft in straight and-level-flight, lift and weight would be equal and acting directly opposite to each other considered ``one G`` which is the force gravity exerts upon an object .

- The force of lift during a turn, is separated into two components at right angles to each other resulting the aircraft loses some altitude (unless additional lift is created) .

- One component, which acts vertically and opposite to the weight (gravity), is called the ``vertical component of lift``, and, the other, which acts horizontally toward the center of the turn, is called the ``horizontal component of the lift .

- The horizontal component of lift is the force that pulls the aircraft from a straight flight path to make it turn .



(Relation of horizontal and vertical component of lift, during the turn)

Centrifugal force –

- The centrifugal force is the ``equal and opposite reaction`` of the aircraft to the change in direction and acts equal and opposite to the horizontal component of lift .

Load factor –

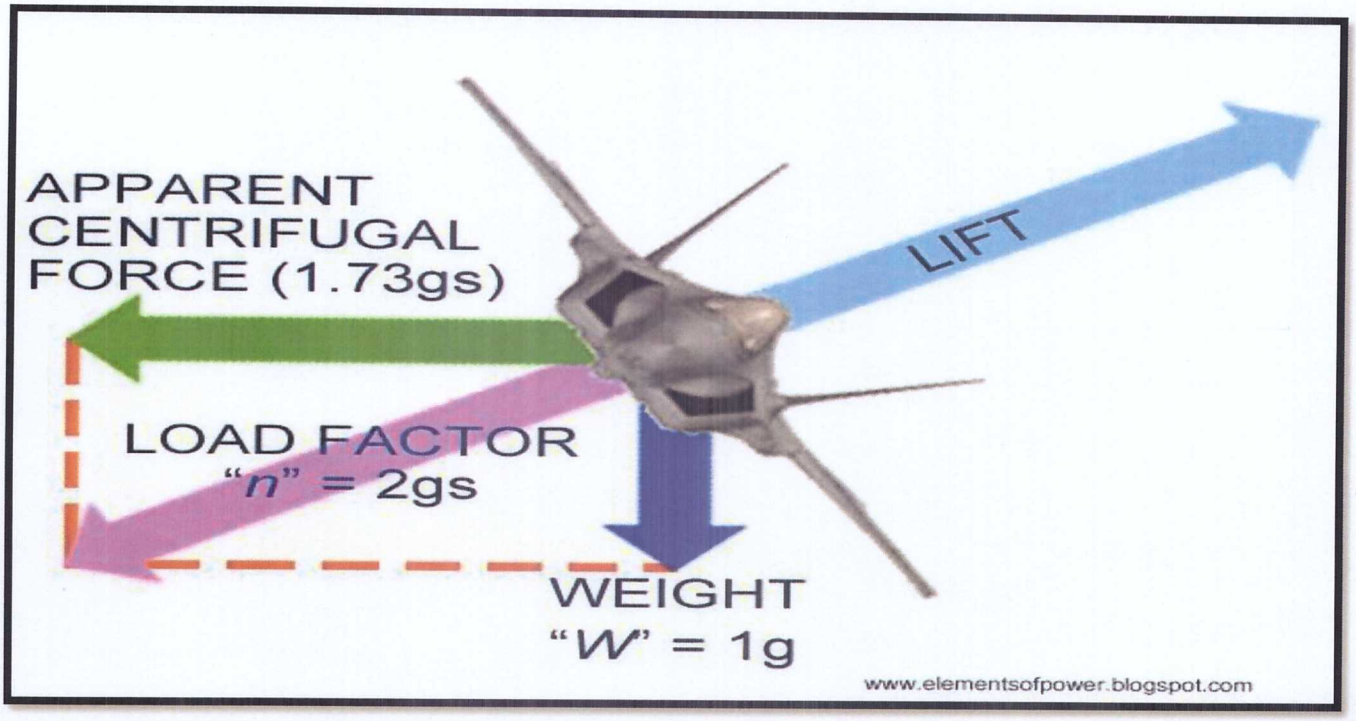
- Any force applied to an airplane to deflect its flight from a straight line, produces a stress on its structure, the amount of this force is termed ``load factor``.

- The load factor is the ratio of the load supported by the airplane`s wing to the actual weight of the airplane and its content .

- If the wings are supporting twice as much weight as the weight of the airplane and its contents, the load factor is two, such as during a 60° bank and maintaining constant altitude .

Limit load factor –

- The limit load factor is the number of G`s (Positive or neative an airplane can sustain without structural damage



- Positive G (when climbing) - Under increasing positive *G*-force, blood in the body will tend to move from the head toward the feet. this can manifest progressively as ``black-out`` .

- Negative G (when descending) - Under negative *g*, the risk of the dangerous condition may occur with too much blood pressure in the head and known as ``red-out eyes`` .

AVIATION PHYSIOLOGY -

- An understanding of how your body and mind work when you fly, is just as important as knowing how the systems and equipment work in your airplane .

- The pilot is, in fact, the most important element in the airplane, and how well he/she functions has a direct influence on flight safety .

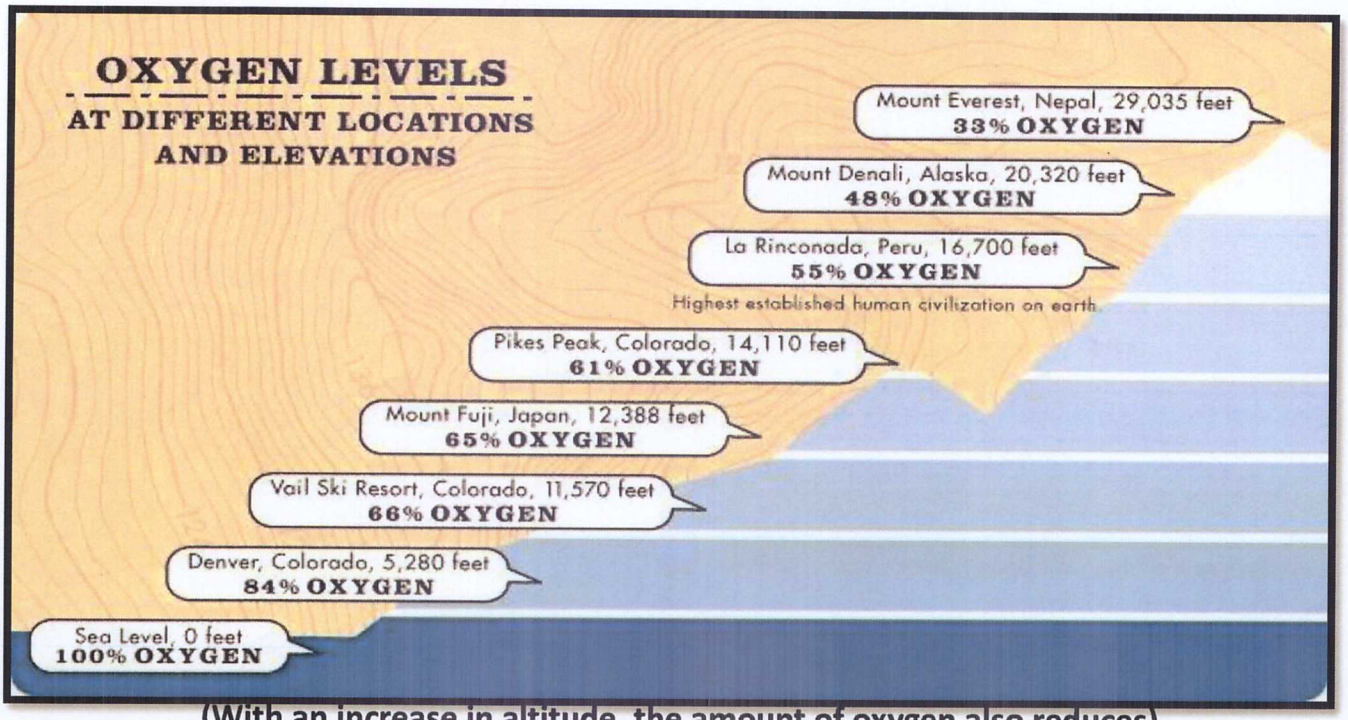
- Aviation physiology is the study of the effects of high altitudes on the body, such as different pressures and levels of oxygen .

- At different altitudes the body may react in different ways , and, producing more erythrocytes .

- These changes cause more energy waste in the body, causing muscle fatigue, but this varies depending on the level of the altitude .

Hypoxia –

- Is the inadequate amount of oxygen to meet the body's metabolic needs at high altitudes .



(With an increase in altitude, the amount of oxygen also reduces)

Altitude	Time of Useful Consciousness
45,000 feet MSL	9 to 15 seconds
40,000 feet MSL	15 to 20 seconds
35,000 feet MSL	30 to 60 seconds
30,000 feet MSL	1 to 2 minutes
28,000 feet MSL	2 1/2 to 3 minutes
25,000 feet MSL	3 to 5 minutes
22,000 feet MSL	5 to 10 minutes
20,000 feet MSL	30 minutes or more

- The onset of hypoxia does not affect all pilots in the same manner, one are more of the following common symptoms may occur :

1) Impaired judgment ; 2) Increased breathing rate ; 3) Light headache or dizzy sensation ;
4) Tingle or warm sensation ; 5) Perspiration ; 6) Reduced visual acuity ;
7) Sleepiness ; 8) Blue coloring of the skin, fingers, and lips ; and 9) Change in behavior

Anoxia – A total absence of oxygen in the blood .

Acceleration - Any change in the speed or direction .

Absorption - A process in which an object collects other materials within itself .

Acclimatization - The physiological adjustment of an organism to a new and physically different environment .

Alkalosis - Caused by abnormally rapid respiration .

Altitude sickness - Refers to symptoms of oxygen deficiency in flying personnel .

Artery - Those blood vessel possessing relatively thick muscular walls, which transport oxygenated blood .

Visual Auto kinesis - The apparent wandering of an object or a light when viewed against a visually unstructured background or dark background is called auto kinesis .

Barometric pressure - The pressure of the air in a particular environment as measured by the barometer .

Cyanosis - Blueness of the skin due to insufficient oxygen of the blood .

Dark adoption - The process which the night seeing cells increases its ability .

Decibel - An arbitrary unit for measuring the relative intensity of a sound .

Decompression - Any reduction in in the pressure of one`s surrounding .

Eustachian tube - The passage way leading the middle ear to the pharynx, which equalize the air pressure to the middle ear .

Hemoglobin - An organic, chemical compound within the red blood cells .

Hyperventilation - Hyperventilation can be described as excessive over-breathing in excess of the metabolic needs of the body .

Disorientation - Is the inability to determine one's position, location, and motion relative to their environment .

- Disorientation to a pilot is a sense of confusion about the attitude of the aircraft and an awareness of conflicting sensations .

(THE END)

(GOOD LUCK AND HAVE NICE AND SAFE FLIGHTS)