CHAPTER 1

INTRODUCTION TO IAF

Q1. Which is the youngest of the three services? Briefly explain the birth of IAF.

Ans The Indian Air Force is the youngest amongst the three services. Even though young it has a bright history. The bravery, valour achievement of the officers and airmen of the IAF are integral Part of its proud heritage.

The Government passed the IAF bill on 4 April 1932. The Indian Air Force came into being with the promulgation of the IAF bill on 8 Oct 1932.The Indian Air force anniversary is celebrated on 8 Oct every year.

Q2. List the five operational Commands of IAF with the location of their HQs.

Ans (a) Western Air Command (WAC) - New Delhi
(b) South Western Air Command (SWAC) - Gandhinagar (Gujrat)
(c) Eastern Air Command (EAC) - Shillong (Meghalaya)
(d) Central Air Command (CAC) - Allahabad (UP)
(e) Southern Air Command (SAC) - Thiruvananthapuram (Kerala)

Q3. List the two functional Commands of IAF with the location of their HQs.

Ans (a) Training Command - Bengaluru (Karnataka).
(b) Maintenance Command - Nagpur (Maharashtra).

Q4. What is the difference between the Armed Forces and Police organisations?

Ans The principal national-level organisation concerned with law enforcement is the Ministry of Home Affairs (MHA) with all matters pertaining to the maintenance of public peace and order.

Defence Services play a vital role in maintaining sovereignty and territorial integrity of our nation and is governed by the Defence Ministry. All elements of national defence and national security strive in achieving the assigned role and task

Q5. What are the primary roles of Army Air Force and Navy?

Ans The primary role of the services is to ensure national security and territorial integrity, defending the nation from external aggression and internal threats, and maintaining peace and security within its borders.

The primary objective of the Navy is to secure the nation's maritime borders. Our country is covered almost from three sides with water with a coastline of approximately over 6000 Km. The sea around India has impact / effect on India’s

freedom, trade, commerce, and culture. The Indian Navy (Bhartiya Nau Sena) is the naval branch of the Indian Armed Forces

The primary role of the Air Force is the air defence of the country, means Guarding of our air space from enemy intrusion and giving support to the Army and the Navy

Q6. What are the awards given to the Armed Forces, CAPF & Police?

Ans The awards given to the Armed Forces, CAPF & Police are enumerated below:-

(a) Gallantry Awards in the Face of Enemy (War Time).
(b) Gallantry Awards Other than in the Face of Enemy (Peace Time).
(c) Non-Gallantry Awards /Distinguished Service Awards.

Chapter 2

MODES OF ENTRY IN THE IAF & CIVIL AVIATION

Q1. List the various modes and the essential requirements of joining the IAF as a commissioned officer.

Branch	Qualification	Age (yrs)
Flying Branch		
(a) National Defence Academy (NDA) For Men only	10+2 With Physics & Math	16 1/2 -19
(b) Combined Defence Service Exam (CDSE) For Men only	Any Grad. With Physics & Math at 10+2 or BE	19 - 23
(c) NCC Special Entry (Through Commanding Officer of NCC unit /DG NCC) For Men only	Any Grad. with Physics & Math at 10+2 or BE & NCC Air Wing Sr Div. 'C' Certificate	19 - 23
(d) Short Service Commission (For Women only)	Any Grad. With Physics Maths at10+2 or BE	19 - 23
Technical Branch (PC For Men/ SCC For Women)		
(a) Aeronautical Engineering (Electronics) (b) Aeronautical Engineering (Mechanical)	First class degree in Engineering or GATE score of 70% & above in Electronics / Mechanical/ Allied subjects as per advertisement	18 - 28
Ground Duty Branch (PC For Men / SCC For Women)		
(a) Administration (b) Logistics (c) Accounts	First Class Graduate or PG in subjects as per advertisement	20-23 20-25
(d)Education (e) Meteorology	PG in subjects as per advertisement	20-25

Q2. List the various modes and the essential requirements of joining the IAF as an airman.

GROUP	*AGE (As on date of Enrolment)	EDUCATIONAL QUALIFICATION
Group 'X' (Technical) Trades	17 - 22 Years	Passed Intermediate / 10+2 / equivalent examination with Mathematics, Physics and English with a minimum of 50% marks in aggregate. **OR** Three years Diploma course in Engineering (Mechanical / Electrical / Electronics / Automobile / Computer Science / Instrumentation Technology / Information Technology) with at least 50% marks in overall aggregate from a Government recognised Polytechnic Institute.
Group 'X' (Education Instructor) Trade	20-25 Years	Graduate in Arts, Commerce or Science with B. Ed degree/two years teaching experience in a Government recognised School/College. Candidate should have scored a minimum of 50% marks in aggregate in Graduation as well as B. Ed. **OR**
	20-28 Years	Passed MA English / M Sc in Mathematics, Physics, Computer Science / MCA with B Ed degree /2 Years teaching experience in a Government recognised School / College.
Group 'Y' Trades (Except Med Asst and Musician Trade)	17-22 Years	Passed Intermediate /10+2 / equivalent examination with Science, Arts or Commerce subjects or equivalent vocational course with minimum 50% marks in aggregate. Vocational courses should be recognised by Association of Indian Universities. **OR** Three years Diploma in any stream of Engineering from a Government recognised Polytechnic Institute.
Group 'Y' (Med Asst) Trade	17-22 Years	Passed 10+2 / Intermediate / equivalent exam with Physics, Chemistry, Biology and English with a minimum of 50% marks in aggregate.
Group 'Y' (Musician) Trade	17-25 Years	Passed Matriculation /10th class or equivalent with minimum pass marks from any Government recognised School/Boards and should be proficient in playing at least one of the following musical instrument: Trumpet / Bass / Violin / Saxophone / Clarinet / Euphonium / Jazz-Drum / Piccolo / Bass Trombone / Key Board / Guitar / Sarod / Viola / Cello / Contra Bass (String Bass).

Q3. What are the Job Contents for the Airmen?

Ans (a) **Group 'X' (Technical) Trades**. In this trade you are responsible for maintenance and repair of all types of light and heavy duty mechanical vehicles, cranes and loading equipment etc. The trades are :-

(i) Electronics Fitter
(ii) Electrical Fitter
(iii) Mechanical System Fitter
(iv) Structures Fitter
(v) Propulsion Fitter
(vi) Workshop Fitter (Smith)
(vii) Workshop Fitter (Mechanical)
(viii) Weapon Fitter

(b) **Group 'X' (Non – Technical)Trade.** Education Instructor

(c) **Group 'Y" (Non –Technical)** Trades Deals with all support services like Administration accounts etc. The trades are **:-**

(i) Adm Assistant
(ii) Accts Assistant
(iii) Medical Assistant
(iv) Logistics Assistant
(v) Environment Support Services Assistant (ESSA)
(vi) Ops Assistant
(vii) Meteorological Assistant
(viii) Ground Training Instructor
(ix) Indian Air Force (Police)
(x) Indian Air Force (Security)
(xi) Musician

(d) **Group 'Y' (Technical) Trades.**

(i) Communication Technician
(ii) Automobile Technician

Chapter 3

AIRCRAFT RECOGNITION

Q1. How do we identify the aircraft ?

Ans There are various methods used to identify the aircraft:- Wing position, Shape of canopy, Wing shape, Shape of fins & tail plane, Shape of wing tips and finally the Markings.

Q2 What is marking of IAF aircrafts ?

Ans The IAF aircraft has a roundel which is concentric circles of 'Saffron, White and Green'.

Q3. What are variants of fighter aircraft in the inventory of IAF?

Ans The fighter aircrafts in IAF are SU-30 MKI, Mirage-2000, MiG-29, MiG-27, MiG-21BISON and Jaguar.

Q4. What are variants of transport aircraft in the inventory of IAF?

Ans The transport aircrafts in IAF are C-130J, C-17,IL-76, AN-32, Embraer, Avro, Dornier, Boeing 737-200.

Q5. What are variants of helicopters in the inventory of IAF?

Ans The helicopters flown by IAF are MI-25 / MI-35, MI-26, MI-17 V5, Chetak, Cheetah & ALH.

Q6. What are variants of training aircraft in the inventory of IAF?

Ans Kiran, Hawk and Pilatus PC-7 are the trainer aircrafts used for training in IAF.

Q7. Which are the Indian manufactured aircraft in IAF ?
Ans Made in India aircrafts are, Light Combat Aircraft (LCA). Light Combat Helicopter (LCH). Advanced Light Helicopter (ALH) or Dhruv.

CHAPTER 4

LATEST TRENDS & ACQUISTIONS

Q1. Name some of the gifts of modern technology to aviation field.

Ans Modern inventions or equipment have revolutionised the field of aviation. Autopilot, Fly by Wire, UAV, Glass cockpit Technology etc. are the gifts of modern technology.

Q2. What does autopilot do?

Ans An autopilot is designed to perform some of the tasks of the pilot. A single, two axis or three axis autopilot controls an aircraft in the roll, yaw and pitch axis respectively.

Modern autopilots use computer software to control the aircraft. The software reads the aircraft's current position, and then controls a Flight Control System to guide the aircraft.

Q3. What is the difference between fly by wire and fly by optics?

Ans In Fly-by-wire (FBW) the movements of flight controls are converted to electronic signals transmitted through wires (hence the fly-by-wire term), and flight control computers determine how to move the actuators at each control surface to provide the ordered response. The fly-by-wire system also allows automatic signals sent by the aircraft's computers to perform functions without the pilot's input and automatically help stabilize the aircraft. Fly-by-optics use optic fiber to transfer input signals. It is sometimes used instead of fly-by-wire because it can transfer data at higher speeds. The cables are just changed from electrical to fiber cables.

Q4. What do you know about Fly by optics and power by wire?

Ans Fly-by-optics is sometimes used instead of fly-by-wire because it can transfer data at higher speeds the cables are just changed from electrical to fiber cables.

In Power-by-wire the power circuits power electrical or self-contained electro hydraulic actuators that are controlled by the digital flight control computers. All benefits of digital fly-by-wire are retained along with elimination of bulky and heavy hydraulic circuits.

Q4. What is an UAV / RPV?

Ans The UAV / RPV is an acronym for Unmanned Aerial Vehicle / Remotely Piloted Vehicle, which is an aircraft with no pilot on board. UAVs/ RPVs can be remote controlled aircraft (e.g. flown by a pilot at a ground control station) or can fly autonomously based on pre- programmed flight plans.

Q5. What are the new acquisitions in IAF ?

Ans Rafale, Chinook, S-400 are some of the latest acquisitions in IAF.

Q6. What are the types of UAV / RPV?

Ans Types of UAV/RPV are Target and Decoy, Reconnaissance, Combat and R&D :-

(a) Target and Decoy. Providing ground and aerial gunnery a target an enemy aircraft or missile that simulates aircraft.
(b) Reconnaissance. Providing battlefield intelligence.
(c) Combat. Providing attack capability for high-risk missions.
(d) Research and Development - Used to further develop UAV technologies to be integrated into field deployed UAV aircraft.

Q7. What do you understand by glass cockpit?

Ans A glass cockpit is an aircraft cockpit that features electronics instrument displays rather than mechanical gauge. A glass cockpit uses displays driven by flight management system that can be adjusted to displays flight information as needed. This simplifies aircraft operation and navigation and allows pilot to focus only on the most pertinent information. They are also popular with airlines companies as they usually eliminate the need for a flight engineer.

CHAPTER 5

AIR CAMPAIGNS

INDO PAK WAR- 1971

Q1. Why did the Indo-Pak war of 1971 take place?

Ans Pakistan had clamped down upon Bangladesh (erstwhile East Pakistan) resulting in 11 million refugees crossing into our borders from East Bengal. The war was also aimed at the collapse of military rule and the triumph of democracy.

Q2. Why and by whom was the state of emergency declared in 1971?

Ans It was felt that a state of emergency be declared in the country in order to combat the aggression. The decision was subsequently endorsed by the full cabinet and within five hours of the Pakistani attack, President VV Giri proclaimed a national emergency at 11 PM under article 353 of the constitution.

Q3. Who were the Mukti Fauj and Mukti Bahini?

Ans The East Pakistan Rifles and East Bengal Regiment became the Mukti Fauj and Mukti Bahini and later the Mukti Bahini was joined by thousands of young East Bengal's determined to sacrifice their lives for freedom.

Q4. Name two IAF aircraft involved in the 1971 Air Campaign

Ans Gnats and MIG-21s

Q5. What was the codename assigned to the Indian Air Force's strike to support the Ground troops during Operation Vijay ? What was unique about this operation?

Ans Operation Safed Sagar was the codename assigned to the Indian Air Force's strike to support the Ground troops during Operation Vijay that was aimed to flush out Regular and Irregular troops of the Pakistani Army from vacated Indian Positions in the Kargil sector along the Line of Control. It was the first large scale use of air power in the Jammu and Kashmir region since the Indo-Pakistan War of 1971

Q6. Name the aircraft employed in various roles during op 'Safed Sagar'.

Ans Flying from the Indian airfields of Srinagar, Avantipur and Adampur, ground attack aircraft MIG-21s, MIG-23s, MIG-27s, Jaguars and Mirage 2000 were employed in strike role.The choppers used were Mi-8 and the Mi-17. The transport planes were Avro, An-32 and IL-76. They were employed in Transport Support Roles. Canberras were used in recce missions.

Q7. What was the key to achieving success in op 'Safed Sagar'?

Ans After the loss of an Mi-17 Helicopter to a shoulder fired missile near Tololing, IAF changed its strategy and technology. With the Israelis providing around 100

Laser-guided bomb kits to the Indian Military, the Air Force chose to make maximum use of this and retaliated with regular sorties on Pakistani occupied bunkers. The aircraft operated at 10,000 meters AGL (33,000 feet above sea level), well out of range of enemy weapons. There were hundreds of sorties on the intruders with no further material or personnel casualties enabling a gradual takeover of the mountain posts by Indian troops.

Q8. Write a short note on Marshal of the Indian Air Force Arjan Singh.

Ans Arjan Singh was Marshal of the Indian Air Force. Arjan Singh, DFC was born on 15 April 1919. He is the only officer of the Indian Air Force to be promoted to five-star rank in 2002, equal to a Field Marshal. He was born in the Punjab town of Lyallpur, British India, into Aulakh family. Educated at Montgomery, India (now in Pakistan), he entered the RAF College Cranwell in 1938 and was commissioned as a Pilot Officer in December 1939. As a distinguished graduate of the RAF College, Singh's portrait is found on the walls of the College's west stair case. He led No. 1 Squadron, Indian Air Force during the Arakan Campaign in 1944. He was awarded the Distinguished Flying Cross (DFC) in 1944, and commanded the Indian Air Force Exhibition Flight in 1945. He was Chief of the Air Staff (CAS), from 1 August 1964 to 15 July 1969, and was awarded the Padma Vibhushan in 1965. He also became the first Air Chief Marshal of the Indian Air Force when, in recognition of the Air Force contribution in the 1965 war, the rank of the Chief of Air Staff was upgraded to that of Air Chief Marshal. After he retired in 1969 at the age of 50, he was appointed the Indian Ambassador to Switzerland in 1971. He concurrently served as the Ambassador to the Vatican. He was member of the Minorities Commission, Government of India from 1975-1981. He expired on 16th Sep 2017.

Q9. Write a short note on Wing Commander Rakesh Sharma ?

Ans Wing Commander Rakesh Sharma, AC, is a former Indian Air Force test pilot who flew aboard Soyuz T-11 as part of the Inter-cosmos program. He was the first Indian to travel in space. He was born on January 13, 1949 in Patiala, Punjab. He joined the Indian Air Force in 1970 as a pilot officer. In the 1971 War, Sharma flew missions in MiG aircraft with considerable success. He was a Squadron leader with the Indian Air Force, when he embarked on a historic space mission. Sqn Leader Rakesh Sharma, joined two other Soviet cosmonauts aboard the Soyuz T-11 spacecraft which blasted off on April 2, 1984 as part of a joint space program between the Indian Space Research Organisation and the Soviet Inter Cosmos Space Program, and spent eight days in space aboard the Salyut 7 space station. He did life sciences and materials processing experiments. He is also reported to have experimented with practicing Yoga to deal with the effects of prolonged orbital space flight.

Q10. What was Rakesh Sharma’s reply to the then Prime Minister Indira Gandhi’s Question“how does India look from space”

Ans "Saare Jahan se Achcha Hindustan Hamara" meaning 'Our land of Hindustan, is the Best in the world'.

CHAPTER 7

PRINCIPLE OF FLIGHT

Q1. What is mass? What is weight? What is the difference between the two?

Ans. (a) Mass. 'The quantity of matter in a body.' The mass of a body is a measure of how difficult it is to start or stop, ("a body", in this context, means a substance. Any substance a gas, a liquid or a solid).

(b) Weight. The earth exerts a certain force towards its centre on all objects on its surface. This force is called Weight of the body and is equal to the mass of the body multiplied by the acceleration due to gravity 'g'.Unit - Newton (N) - 'The force due to gravity'. (F = m x g)

This implies that mass is constant irrespective of location, whereas weight may change with change in location

Q2. What is the difference between speed and velocity?

Ans. Speed is the rate of change of position. It is a scalar quantity. Whereas Velocity is speed in particular direction. Velocity is a vector quantity having both magnitude and direction.

Q3. What is the acceleration?

Ans. Acceleration is the rate of change of velocity. The change may be in magnitude or direction or in both.

Q4. Describe Newton's three laws of motion.

Ans. (a) **Newton's First Law of Motion**. A body will continue to be in state of rest or of uniform motion in a straight line unless acted upon by an external force. This property of all bodies is called inertia and a body in such a state is said to be in Equilibrium.

(b) **Newton's Second Law of Motion**. The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction of the application of the said force.

(c) **Newton's Third Law of Motion**. For every action, there is an equal and opposite reaction.

Q5. Describe Force and Pressure.

Ans. Force is 'A push or a pull' ,that causes or tends to cause a change in motion of a body. Pressure is force per unit area.

Q6. Describe Law of conservation of energy.

Ans The sum total of all energy in the universe remains constant.

Q7. What is Centre of Gravity?

Ans. It is the point through which the weight of an aircraft acts. An aircraft in flight is said to rotate around its CG. The CG of an aircraft must remain within certain forward and aft limits, for reasons of both stability and control.

Q8. Describe Kinetic Energy.

Ans 'The energy possessed by mass because of its motion'. 'A mass that is moving can do work in coming to rest'. Its Unit is Joule (J) -

KE = 1/2 m V2 joules

PRINCIPLE OF FLIGHT - GLOSSARY OF TERMS

Q1. What is an aerofoil?

Ans. It is a body designed to produce more lift than drag. A typical aerofoil section is cambered on top surface and is more or less straight at bottom.

Q2. What is chord line and chord length of an aerofoil?

Ans. Chord line is a line joining the centres of curvature of leading and trailing edges of an aerofoil section.

Chord length is the length of chord line intercepted between the leading and trailing edges.

Q3. What is Angle of Attack?

Ans. It is the angle between the chord line and the relative air flow undisturbed by the presence of aerofoil.

Q4. What is Total Reaction?

Ans. It is one single force representing all the pressures (force per unit area) over the surface of the aerofoil. It acts through the centre of pressure which is situated on the chord line.

Q5. Describe Lift and Drag.

Ans. Lift is the vertical component of total reaction, resolved at right angles to the relative airflow.
Drag is the horizontal component of the total reaction, acting angles and in the same direction as the relative airflow.

Q6 What is Angle of Incidence?

Ans The angle between the chord line and the longitudinal axis of the aircraft.

CHAPTER 8

FORCES ACTING ON AIRCRAFT

Q1. What are the four forces acting on an aircraft in flight. Explain with a diagram.

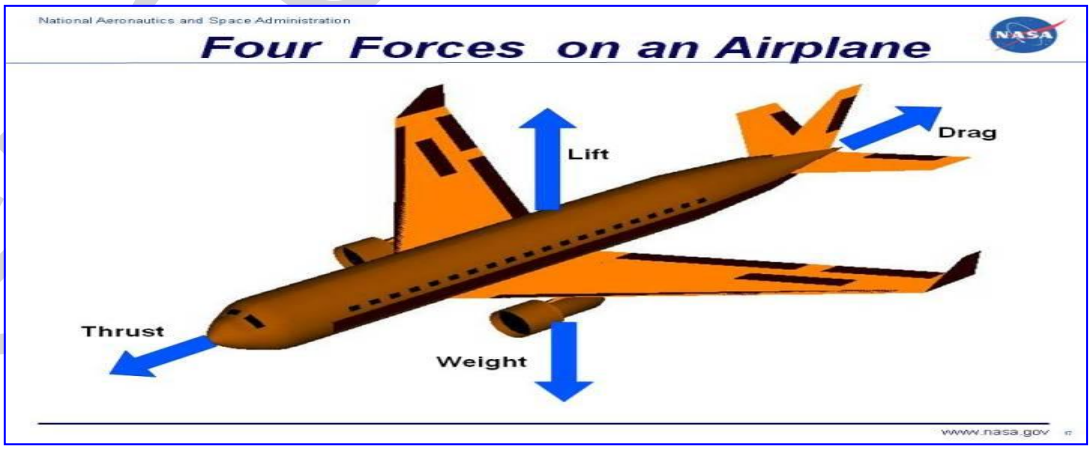
Ans The four forces acting on an aircraft in flight are :-

(a) Lift is a positive force caused by the difference in air pressure under and above a wing. The higher air pressure beneath a wing creates lift, and is affected by the shape of the wing. Changing a wing's angle of attack affects the speed of the air flowing over the wing and the amount of lift that the wing creates.

(b) Weight is the force that causes objects to fall downwards. In flight, the force of weight is countered by the forces of lift and thrust.

(c) Thrust is the force that propels an object forward. An engine spinning a propeller or a jet engine expelling hot air out the tail pipe are examples of thrust. In bats, thrust is created by muscles making the wings flap.

(d) Drag is the resistance of the air to anything moving through it. Different wing shapes greatly affect drag. Air divides smoothly around a wing's rounded leading edge, and flows neatly off its tapered trailing edge...this is called streamlining.



Q2. What are the Flaps and slats?

Ans Flaps are hinged surfaces mounted on the trailing edges of the wings of a fixed- wing aircraft to reduce the speed at which an aircraft can be safely flown and to increase the angle of descent for landing. They shorten take-off

and landing distances. Flaps do this by lowering the stall speed and increasing the drag.

Slats are aerodynamic surfaces on the leading edge of the wings of fixed-wing aircraft which, when deployed, allow the wing to operate at a higher angle of attack. A higher coefficient of lift is produced as a result of angle of attack and speed, so by deploying slats an aircraft can fly at slower speeds, or take off and land in usually shorter distances. They are used while landing or performing manoeuvres which take the aircraft close to the stall but are usually retracted in normal flight to minimize drag.

Q3. Explain effect of FLAPS with lift equation.

Ans The general airplane lift equation: $L = \frac{1}{2} \rho V^2 S C_L$

where:
L is the amount of *Lift* produced, ρ is the air density,
V is the indicated airspeed of the airplane or the *Velocity* of the airplane,
S is the platform area or *Surface area* of the wing
C_L is the *lift coefficient* which is determined by the camber of the airfoil used, the chord of the wing and the angle at which the wing meets the air (or angle of attack)?

Here, it can be seen that increasing the area (S) and lift coefficient (amount of lift to be generated at a lower airspeed (V). Flaps also increase the drag of Aircraft.)

Q4. What are the different types of Slats?

Ans Slats are like flaps only but extended over the leading edge of the wings. There are three types of Slats.

(a) Automatic. The Slat lies flush with the wing leading edge until reduced aerodynamic forces allow it to extend by way of aerodynamics when needed.
(b) Fixed. The Slat is permanently extended. This is sometimes used on specialist low-speed aircraft (these are referred to as slots) or when simplicity takes precedence over speed.
(c) Powered. The Slat extension can be controlled by the pilot. This is commonly used on airliners.

Q 5. What is stall?

Ans Stall is a reduction in the lift coefficient generated by foil as angle of attack increases. This occurs when the critical angle of attack of the foil is exceeded. The critical angle of attack is typically about 15 degrees, but it may vary significantly depending on the fluid, foil, and Reynolds number. Stalls in fixed-wing flight are often experienced as a sudden reduction in lift as the pilot increases angle of attack and

exceeds the critical angle of attack (which may be due to slowing down below stall speed in level flight. A stall does not mean that the engine(s) have stopped working or that the aircraft has stopped moving. The effect is the same even in an unpowered glider aircraft.

Aerodynamically a Stall is a condition wherein when the angle of attack increases beyond a certain point such that the lift begins to decrease. The angle at which this occurs is called the critical angle of attack. This critical angle is dependent upon the profile of the wing, its platform, its aspect ratio, and other factors but is typically in the range of 8 to 20 degrees relative to the incoming wind for most subsonic air foils. The critical angle of attack is the angle of attack on the lift coefficient versus angle-of-attack curve at which the maximum lift coefficient occurs.

Q6. What is stalling speed?

Ans It is the speed below which the airplane cannot create enough lift to sustain its weight in flight. In steady, unaccelerated (1g) flight, the faster an airplane goes, the less angle of attack it needs to hold the airplane up (i.e., to produce lift equal to weight). As the airplane slows down, it must increase angle of attack to create the same lift (equal to weight). As the speed slows further, at some point the angle of attack will be equal to the critical (stall) angle of attack. This speed is called the "stall speed". The angle of attack cannot be increased to get more lift at this point and so slowing below the stall speed will result in a descent. The stall speed will vary depending on the airplane's weight, altitude, and configuration (flap setting, etc.)

Q7. What is thrust?

Ans Thrust is a reaction force described quantitatively by Newton's second and third laws. When a system expels or accelerates mass in one direction, the accelerated mass will cause a force of equal magnitude in opposite direction. A propeller converts shaft power from the engine into thrust. It does this by accelerating a mass of air rearwards. Thrust from the propeller is equal to the mass of air accelerated rearward multiplied by the acceleration given to it. A mass is accelerated rearwards and the equal and opposite reaction drives the aircraft forwards

Thrust is a mechanical force, so the propulsion system must be in physical contact with a working fluid to produce thrust. Thrust is generated most often through the reaction of accelerating a mass of gas. Since thrust is a force, it is a vector quantity having both a magnitude and a direction. The engine does work on the gas and accelerates the gas to the rear of the engine; the thrust is generated in the opposite direction from the accelerated gas. The magnitude of the thrust depends on the amount of gas accelerated and on the difference in velocity of the gas through the engine.

CHAPTER 9

AIRMANSHIP

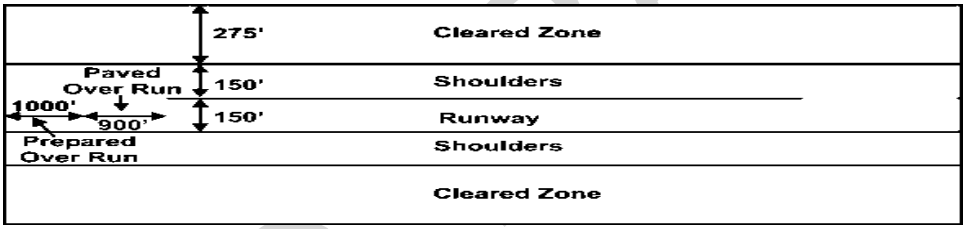
AIRFIELD LAYOUT

Q1. What are the movement areas in an aerodrome?

(a) Runway
(b) Taxi track or taxiway
(c) Apron
(d) Dispersal

Q2. What is a flight strip. Explain with a neat diagram.

Ans It is the rectangular portion of an airfield containing the runway and paved over-runs along with the shoulders and cleared zones.



Q3. Define a runway.

Ans Runways are paved surfaces intended for take-off and landing run of aircraft. The number and orientation of runways at an airfield will depend upon the volume of traffic, runway occupancy time and climatological data on surface winds

Q4. What are taxiways?

Ans These are paved surfaces provided for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another.

Q5. What is the use of shoulders adjacent to runway?

Ans These are areas immediately adjacent to the edges of the runway, taxiways, over-runs and SGAs prepared for accidental or emergency use in the event of an aircraft running off the paved surface.

Q6. List the types of aerodrome markings.

Ans Aerodrome ground markings shall consist of the following:-

(a) Runway markings.

(b) Taxiway markings.
(c) Unserviceability markings.

Q7. What are the various types markings on runway?

Ans Runway markings shall consist of:-

(a) Runway designation marking
(b) Runway centre line markings
(c) Runway threshold markings
(d) Runway touch-down zone markings
(e) Runway side strip markings

Q8. What are the various types markings on taxiways?

Ans Taxiway markings shall consist of:-

(a) Taxiway centre line markings
(b) Runway holding position markings
(c) Taxiway side strip markings

Q9. What is VMC or Visual Meteorological Conditions

Ans Visual Meteorological Conditions are said to exist when the prevailing visibility, distance from cloud, and ceiling are equal to or better than the specified minimum. In Flight the criteria are:-

(a) Visibility: 5 nm / 8 km.
(b) Distance from cloud: 200 yards / 1.5 km horizontally and 1000 feet / 200 meters vertically.

Q 10. What are Special VFR Flights.

Ans VFR Flights, specially authorised can be permitted even in weather conditions below VMC, subject to obtaining ATC clearance. Such flights are known as Special VFR flights.

Q 11. How can one change from VFR to IFR flight?

Ans VFR flight when electing to change to IFR shall:-

(a) Communicate the necessary changes to be effected to its current flight plan.
(b) Submit a flight plan to the appropriate ATS unit and obtain clearance prior to changing over the IFR flight when in controlled airspace.
(c) When operated during night with exception of such local flights as may be exempted by the Air Traffic Control. For this purpose, the local flight is wholly conducted in the immediate vicinity of the aerodrome.

(d) When operated more than 100 nm seaward from the coast-line in controlled

Q 12 How can one change from IFR to VFR flight?

Ans To change from IFR to VFR, aircraft shall be equipped with suitable instruments and with navigational aids appropriate to the route to be flown. An IFR flight electing to change to Visual Flight Rules, shall notify the appropriate unit, specifically, that the IFR flight is cancelled and communicate the change to be made to its current flight plan.

Q 13. Explain the terms used in circuit approach and landing.

Ans (a) The upwind side is the area on the opposite side of the landing runway from the downwind leg. Approach should be made into this area at or above circuit height.

(b) The circuit joining **crosswind** is a corridor, lying within the airspace between the centre of the landing runway and its upwind end, linking the upwind side and the downwind leg.

(c) The **downwind leg** is a flight path, opposite to the direction of landing, which is parallel to and at a sufficient distance from the landing runway to permit a standard rate–one turn to the base leg.

(d) The **base leg** is a flight path at right angles to the direction of landing and sufficiently downwind of the approach end of the landing run-way to permit at least a ¼ mile final approach leg after completion of a standard rate – one turn to final approach.

(e) The **final approach** leg is a flight path in the direction lf landing, commencing at least ¼ mile from the runway threshold, wherein an airplane is in line with the landing runway and descending towards the runway threshold.

Q14. What is Air Traffic Services?

Ans Services provided for the safe and efficient conduct of flight are termed as Air Traffic Services.

Q 15. What are the Objectives of Air Traffic Services.

Ans Objectives of Air Traffic Services are:-

(a) To prevent collision between aircraft.
(b) To prevent collision between aircraft on the manoeuvring area and obstructions on that area.
(c) To expedite and maintain an orderly flow of traffic.
(d) To provide advice and information useful for the safe and efficient conduct of flights.

(e) To notify appropriate organisations regarding aircraft in need of search and rescue aid and assist such organisation as required.

Q16. What do Air traffic Services include?

Ans The ATS include the following:-

(a) Air Traffic Control Services:-

(i) Area Control Service.
(ii) Approach Control Service.
(iii) Aerodrome Control Service.

(b) Flight Information Service.
(c) Air Traffic Advisory Service.
(d) Alerting Service.

Q17. What are Air Traffic Service Units.

Ans Air Traffic Service Units can be categorised into following :-

(a) Approach Control Office. A unit established to provide air traffic control service to controlled flights arriving at or departing from, one or more aerodromes.

(b) Aerodrome Control Tower. A unit established to provide air traffic control service to aerodrome traffic.

CHAPTER – 10

AVIATION MEDICINE

Q1. What is Hypoxia?

Ans Hypoxia can be defined as a lack of sufficient oxygen in the body cells or tissues. Hypoxia comes on without warning of any kind, supplementary oxygen must be available in any aircraft that will be flown above 10,000 Feet. The general rule of oxygen above 10000 ASL by day and above 5000 ASL by night is essential.

Effects of Hypoxia progress from euphoria (feeling of well-being) to reduced vision, confusions, inability to concentrate, impaired judgment, and slowed reflexes to eventual loss of consciousness. The first evidence of hypoxia occurs at 5000 feet in the form of diminished night vision. Instruments and maps are misread, dimly lit ground features are misinterpreted. Above 10000 Feet there is a definite but undetectable Hypoxia. This altitude is the highest level at which a pilot should consider himself efficient in judgment and ability. However, continues operation even at this altitude for period of more than, say 4 hours can produce fatigue because of the reduced oxygen supply and a pilot should expect deterioration in concentration, problem solving and efficiency.

Q2. What is hyperventilation?

Ans Hyperventilation, or over breathing, is an increase in respiration that upsets the natural balance of oxygen and carbon dioxide in the system, usually as a result of emotional tension or anxiety. Under conditions of emotional stress, fright or pain, a person may unconsciously increase his rate of breathing, thus expelling more carbon dioxide than is being produced by muscular activity. The result is a deficiency of carbon dioxide in the blood. The most common symptoms are dizziness, tingling of the toes and fingers, hot and cold sensations nausea and sleepiness. Unconsciousness may result is the breathing rate is not regulated.

Q3. What is ear block? How to counter the ear block?

Ans The ear is composed of three sections. The outer ear is the auditory canal and ends at the eardrum. The middle ear is a cavity surrounded by bones of the skull. It houses the organs of hearing and is filled with air. The Eustachian tube connects the middle ear to the throat. The inner ear controls certain equilibrium senses and contains the cochlea, a small organ that analyses sound vibrations. During ascent and descent, air must escape or be replenished through the Eustachian tube to equalize the pressure in the middle ear cavity with that of the atmosphere. If air is trapped in the middle ear, the eardrum stretches to absorb the higher pressure. The result is pain and sometime temporary deafness. The situation is aggravated if the individual has a cold, and allergy or an infected throat.

Q4. How to counter the ear block?

Ans Pilot and passengers must consciously make an effort to swallow or yawn to stimulate the muscular action of the Eustachian tubes. It is advisable to use the Valsalva technique, that is, to close the mouth, hold the nose and blow gently.

CHAPTER – 11

NAVIGATION

Q1. Define Great Circle.

Ans The circle drawn on the surface of the earth whose plane cuts the earth into two equal halves, eg- the Equator, meridians together with their anti-meridians.

Q2. What is Rhumb Line?

Ans The line cutting all the meridians at the same angle. It thus becomes a regularly curved line. Examples are the Equator and all the meridians.

Q3. What is Equator?

Ans It is a great circle whose plane is perpendicular to axis of rotation of the earth. The equator lies in a east-west direction and divides the earth into northern and southern hemispheres.

Q4. What is Earth Axis?

Ans It is a vertical line joining the two poles of the earth, lying perpendicular to the equator and passing through the centre of the earth.

Q5. What is a Meridian?

Ans A meridian is a half great circle joining the two poles. Every great circle joining the two poles is a meridian and its ante-meridian indicates the North-South direction. A meridian together with its ante meridian is a great circle.

Q6. What are the basic elements required in a map?

Ans The four basic elements required in a map are:

(a) Areas will be shown correctly
(b) Bearing measurement anywhere on the reduced earth will be identical to the measurement on the earth.
(c) Shapes will be correct
(d) Distances will be measured accurately by use of a graduated scale which is provided at the bottom of each map.

Q7. What is Latitude and longitude?

Ans (a) **Latitude**. These are the angular distances along the meridians. The latitude of a place is defined as the arc of its meridian between the equator and the place and is named North or south depending upon its corresponding position in respect to the equator. The latitude is measured in degrees, minutes and seconds form 0° to 90° from the equator.

(b) **Longitude**. These are angular distances along the equator on East or West of the prime-meridian. The longitude of a place is defined as the shorter arc of the equator between the meridian of the place and the prime-meridian. It is measured in degrees, minutes and seconds from 0° to 180°along with suffix East or West of the Prime-Meridian.

Q8. What is relief and how are they indicated on a map?

Ans **Relief.** Mountains, hills, coast lines and other natural features are of considerable interest to a pilot as they are valuable landmarks for navigation purpose or are, sometimes pose dangerous barriers for flight. Relief is indicated on maps and charts in one or more of five different ways:-

(a) Spot heights or depths
(b) Contours and form lines
(c) Layer tints
(d) Hachures
(e) Hill shading

Q 9 What do you mean by scale of a map?

Ans The scale is the ratio of a distance measured on the map to the corresponding distance on the earth surface. Scale on a map is represented commonly by:-

(a) Representative fraction
(b) Graduated scale line
(c) Statement in words.

Q10. What are the commonly used maps in aviation?

Ans Most common maps used in aviation are ¼ million maps, ½ million maps and 1 million maps. ¼ million maps have larger scale than ½ million and ½ million have scale larger than 1 million. A larger scale map represents comparatively lesser ground distance and consequently more ground details can be inserted.

CHAPTER 12

MET AND ATMOSPHERE

Q1 Define atmosphere.

Ans The invisible and odourless gas which we breathe, which sustains life and produces an infinite variety of phenomena is what we call air. The envelope of air surrounding the earth and extending to great heights is the atmosphere where vast physical processes occur, giving rise to the ever changing weather phenomena.

Q2. What is air comprised of? What is the broad composition of dry air?

Ans (a) Air is a mechanical mixture of a variety of gases. The main constituents of this mixture are nitrogen and oxygen, accounting for almost 99% of the whole, with roughly three parts of nitrogen to one part of oxygen. There are small amounts or traces of other gases.

(b) The percentage of composition of dry air by volume is in the proportions as under:-

Nitrogen	-	78.09 %
Oxygen	-	20.95 %
Argon	-	0.93 %
Carbon dioxide	-	0.03 %

Q3 List the layers of the atmosphere along with their respective height bands

Ans The pressure and density decrease as the height increases and the variation of temperature is different. Due to this there is a tendency for the atmosphere to be divided into several spheres is as mentioned below:-

(a)	Troposphere	-	Up to about 11-16 km
(b)	Stratosphere	-	Up to about 50 km above troposphere
(c)	Mesosphere	-	50 to 85 km
(d)	Thermosphere	-	Above 85 km

Q4. Write short notes on International Standard Atmosphere.

Ans A standard atmosphere is defined and used as a basis of references. The most widely used atmosphere for reference purposes is the one defined by ICAO, known as International Standard Atmosphere (ISA) whose specifications are :-

Mean Sea level temperature	-	15°C
Mean Sea level pressure	-	1013.25 mb
Surface density	-	1225 g/m3
Acceleration due to gravity	-	980.665 cm / sec2
Rate of fall of temp with height up to 11 km	-	6.5°C /km (1.98°C / 1000 ft)

Q5 What are Clouds?

Ans The clouds may be defined as visible aggregate of minute particles of water in the free air. Ice or clouds both are formed by cooling of masses of damp air, generated by upward motion and its accompanying expansion with fall of pressure.

Q6. What are the Classification Of Clouds ?

Ans The system of classification which have been proposed, have sometimes been based on the observed appearance of the clouds and at the other times on the supposed method of formation.

Class of family average height forms

(a) High Clouds 20,000 feet and above - Cirrus, Cirro-Stratus, Cirro-cumulus
(b) Medium Clouds 6500 feet to 20,000 feet - Alto-Stratus,Alto-Cumulus
(c) Low Clouds ground level to 6500 feet - Stratus, Strato-Cumulus
(d) Clouds with vertical Base 1500 feet to 6500 feet - Cumulus, Cumulo-Nimbus development but tops reaching high and medium cloud levels

Q7. What are the types of precipitation?

Ans Water droplets or ice crystals in a cloud are usually of such small dimension that they are kept suspended in mid- air by the vertical current at the base of the cloud. These vertical currents are a necessary contribution for the formation of clouds and their maintenance. For the water droplets or ice crystal to overcome the vertical currents and fall under the force of gravity, their diameter should be of the order at least a millimeter or more.The types are:-

(a) Drizzle. Minute water drops falling from the clouds. The drops are so small that they look like spray and are at times blown and carried by wind.
(b) Rain. Medium size water drops falling from layer types of clouds.
(c) Snow. Frozen rain in the form of flakes or ice crystal.
(d) Sleet. Mixture of rain and snow.
(e) Shower. Large drops falling from heap type of clouds.
(f) Thunder storm. A phenomenon in which thunder is heard and lightning is seen. Generally accompanied by sharp shower. They are associated with Cb clouds.
(g) Hail storm. A storm in which solid pellets of ice fall on the ground.

CHAPTER - 13

INTRODUCTION AND TYPES OF AERO ENGINES

Q1. What is and Engine?

Ans An engine is a device where-in energy in one form is converted into another form. Here the heat energy is converted into mechanical energy to produce required propulsion. Aero-engines are machines which transform the potential energy contained in fuel and air either into kinetic or mechanical energy. The gas energy is produced by the combustion of an air-fuel mixture. The forward thrust is produced as per Newton's third law which states that 'for every action, there is an equal and opposite reaction.' The operating cycle (pressure / volume cycle) of a basic aero-engine is Brayton cycle.

Q2. What are the types of Propulsion ?

Ans (a) **Direct Reaction Propulsion**.

(i) In the case of rockets and ram-jets, all the gas kinetic energy is used for propulsion.
(ii) In the case of turbo -jets, the gas kinetic energy is partially used for propulsion, the rest is transformed into mechanical energy.

(b) **Indirect Reaction Propulsion**. In this case, the gas kinetic energy is almost transformed into mechanical energy. Eg: - Turbo shaft and Turbo prop engines.

Q3. What are the operating phases of an Aero Engine?

Ans **Operating Phases**. There are basically five operating phases for any Aero-engine. They are as follows:-

(a) Induction
(b) Compression
(c) Combustion
(d) Expansion
(e) Exhaust

Q4 What are the components of an aero engine?

Ans In an Aero engine, the operating phases are achieved with the help of following components:-

(a) Air intake:Assists in induction of air
(b) Compressor: Assists in compression of air
(c) Combustion chamber : Assists in combustion of fuel and air
(d) Turbine assembly: Assists in expansion of combustion gas
(e) Exhaust assembly: Assists in exhaust of gas

Q5. What is a turboprop engine?

Ans A turboprop engine is simply a turbine engine where a propeller is attached to the low-pressure rotor at the front, via a gearbox. The air that passes through the propeller near its inner diameter also passes through the compressor stages in the core of the engine and is further compressed and is processed through the engine cycle. The air that passes through the outer diameter of the propeller does not pass through the core of the engine ,but instead passes along the outside of the nacelle. The large volume of air pushed backward by the propeller provides airplane thrust in the same way as the smaller, high velocity air from the nozzle of a classic jet engine.

Q6. What are the types of Turbo Prop Engines ?

Ans There are two types of turbo prop engines:-

(a) Single shaft engine
(b) Free turbine engine

Q7. What are the differences between single shaft and free turbine engine?

Ans The differences between single shaft and free turbine engine is in the transmission of power to the propeller.

(a) **Single Shaft**. In a single-shaft engine, the propeller is driven by the same shaft (spool) that drives the compressor. Because the propeller needs to rotate at a lower RPM than the turbine, a Reduction gear box reduces the engine shaft rotational speed to accommodate the propeller through the propeller drive shaft.

(b) **Free Turbine.** In a free-turbine engine, the propeller is driven by a dedicated turbine. A different turbine drives the compressor; this turbine and its compressor run at near-constant RPM regardless of the propeller pitch and speed. Because the propeller needs to rotate at lower RPM than the turbine, a reduction gearbox converts the turbine RPM to an appropriate level for the propeller.

CHAPTER 14

AIRCRAFT CONTROLS

Q1. What is aircraft controls and their classification?

Ans A conventional wing aircraft flight control system consists of flight control surfaces, the respective cockpit controls, connecting linkages, and the necessary operating mechanisms to control an aircraft's direction in flight. Aircraft engine controls are also considered as flight controls as they change speed. Generally basic aircraft control can be classified as follows:-

(a) Primary controls
(b) Secondary controls

Q2. What is Primary and secondary controls in an aircraft

Ans (a) **Primary Controls**. Basically the primary aircraft controls are arranged as follows:-

(i) A control yoke (also known as a control column), centre stick or side-stick governs the aircraft's roll and pitch by moving the ailerons, when turned or deflected left and right, and moves the elevators when moved backwards or forwards.
(ii) Rudder pedals, to control yaw, which move the rudder; left foot forward will move the rudder left for instance.
(iii) Throttle controls to control engine speed or thrust for powered aircraft.

(**b) Secondary Controls**. The secondary controls are trim tab, flap (aircraft), Air brake (aircraft), Spoiler , Leading edge slats, and variable-sweep wing.

(i) Trim Tabs. These are small control surfaces connected to the trailing edge of a larger control surface of aircraft, used to control the trim of the controls. An adjustable trim tab will allow the operator to reduce the manual force required to maintain that position.

(ii) Air brakes and Spoilers. Air Brakes or speed brakes are a type of flight control surface used on an aircraft to increase drag or increase the angle of approach during landing. Spoilers are designed to increase drag while making little change to lift.

(iii) Slats. Slats are aerodynamic surfaces on the leading edge of the wings of fixed- wing aircraft which, when deployed, allow the wing to

operate at a higher angle of attack. A higher coefficient of lift is produced as a result of angle of attack and speed, so by deploying slats an aircraft can fly at slower speeds, or take off and land in shorter distances. They are usually used while landing or performing manoeuvres which take the aircraft close to the stall, but are usually retracted in normal flight to minimize drag.

(iv) Variable - Sweep Wing. A variable-sweep wing , also known as"swing wing", is an aeroplane wing that may be swept back and then returned to its original position during flight. It allows the aircraft's plan form to be modified in flight, and is therefore an example of a variable-geometry aircraft.

(v) Flaps. Flaps are hinged surfaces mounted on the trailing edges of the wings of a fixed- wing aircraft to reduce the speed at which an aircraft can be safely flown and to increase the angle of descent for landing. They shorten take-off and landing distances. Flaps do this by lowering the stall speed and increasing the drag.

Q3. What is meant by fuselage?

Ans Fuselage is the main body of the aircraft to which all the other components are attached. It also contains the cockpit from where the pilot controls the aero-plane. It provides the space for the freight and passengers.

Q4. What are the requirements to design a fuselage?

Ans The basic design of fuselage should satisfy the following:-

(a) Smooth skin of the required aerodynamic form.
(b) Sufficient strength to withstand aerodynamic loads, landing loads and handling loads.
(c) Sufficient stiffness to retain its correct shape under all loads.
(d) Mounting points for engine, armament, fuel tanks and equipment.
(e) Protection of aircrew and passengers from ambient conditions.
(f) Sufficient break down points for easy dismantling for transportation and port- holes accessible for inspection and servicing.
(g) Design itself should be economical and easy for production and repairs.

Q5. What are ailerons and how does it function?

Ans Ailerons are mounted on the trailing edge of each wing near the wingtips and move in opposite directions. When the pilot moves the stick left, or turns the wheel counter-clockwise, the left aileron goes up and the right aileron goes down. A raised aileron reduces lift on that wing and a lowered one increases lift, so moving the stick left causes the left wing to drop and the right wing to rise. This causes the aircraft to roll to the left and begin to turn to the left. Centering the stick returns the ailerons to

neutral maintaining the bank angle. The aircraft will continue to turn until opposite aileron motion returns the bank angle to zero to fly straight.

Q6. What are elevators and how does it function?

Ans An elevator is mounted on the trailing edge of the horizontal stabilizer on each side of the fin in the tail. They move up and down together. When the pilot pulls the stick backward, the elevators go up. Pushing the stick forward causes the elevators to go down. Raised elevators push down on the tail and cause the nose to pitch up. This makes the wings fly at a higher angle of attack, which generates more lift and more drag. Centering the stick returns the elevators to neutral and stops the change of pitch..

Q7. What are rudders and how does it function?

Ans The rudder is a fundamental control surface, typically controlled by pedals rather than at the stick. It is the primary means of controlling yaw-the rotation of an airplane about its vertical axis. The rudder may also be called upon to counter-act the adverse yaw produced by the roll-control surfaces.

On an aircraft, the rudder is a directional control surface. The rudder is usually attached to the fin (or vertical stabilizer) which allows the pilot to control yaw about the vertical axis.

CHAPTER 15

BASIC FLIGHT INSTRUMENTS

Q1. Why are instruments required in aircraft?

Ans The best medium for flying an aircraft is the natural horizon. It is the place where the earth and the sky seem to meet. But during cloudy conditions and at night, the horizon is not visible. During such occasions, the instruments of an aircraft play a very vital role in aiding the pilot to fly the aircraft safely. As flying involves the third dimension, instruments become very important. The instruments also give out the health of the engine and re-assure the pilot that all vital parameters of flying are within the prescribed limits.

Q2. What is an ASI, how does it work?

Ans ASI is Air Speed Indicator and is used in an aircraft to display the craft's airspeed to the pilot. The principle of an Air Speed Indicator is the measurement of two pressures called static and pitot pressures.

The static pressure is due to the pressure exerted by the atmosphere and the dynamic is due to the movement of the tube through the air.

The total pressure is known as pitot pressure and the dynamic pressure is indicated in terms of speed of the aircraft. The dynamic pressure is calculated as, Dynamic = Pitot – Static

Q3. What is an Altimeter and how does it work?

Ans An altimeter is an instrument used to measure the altitude of an object above a fixed level usually the sea level. The altimeter shows the aircraft's altitude above mean sea- level. Altitude can be determined based on the measurement of atmospheric pressure. The atmosphere has weight and this weight exerts pressure. This is known as static pressure. This pressure reduces with height at the rate of 1 millibar / hectapascal per 30 feet approximately. An aneroid barometer is used to measure the atmospheric pressure. An aircraft altimeter is simply an aneroid barometer adapted to use in aircraft calibrated to read the atmospheric pressure in terms of height. This is done by measuring the difference between the pressure in a stack of aneroid capsules inside the altimeter and the atmospheric pressure obtained through the static system. As the aircraft ascends, the capsules expand and the static pressure drops, causing the altimeter to indicate a higher altitude. The opposite effect occurs when descending.

Q4. What is an Artificial Horizon?

Ans The artificial horizon shows the aircraft's attitude relative to the horizon. From this, the pilot can tell whether the wings are level and if the aircraft nose is pointing above or below the horizon. This is a primary instrument for instrument flight and is useful in conditions of poor visibility. An artificial horizon is an instrument used in an aircraft to inform the pilot of the orientation of the aircraft relative to earth. It indicates pitch (fore and aft tilt) and bank or roll (side to side tilt).

CHAPTER-16

INTRODUCTION TO RADARS

Q1. What is a Radar?

Ans Radar is an object detection system which uses radio waves to determine the range, altitude, direction, or speed of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain

Q2. What are the basic parts of a radar?

Ans The basic parts of radar are:-

(a) The transmitter creates the radio waves.
(b) The antenna directs the radio waves.
(c) The receiver measures the waves which are bounced back by the object that the radar is trying to find.
(d) By doing this, the radar can find what place the object is at.

Q3. What is the working principle of Radar?

Ans The radar dish or antenna transmits pulses of radio waves which bounce off any object in their path. The object returns a tiny part of the wave's energy to a dish or antenna which is usually located at the same site as the transmitter. The radar signals that are reflected back towards the transmitter are the desirable ones that make radar work.

Q4. Why is a radar required in an aircraft?

Ans In aviation, aircraft are equipped with radar devices that warn of obstacles in or approaching their path and give accurate altitude readings.

Q5. What are the types of radar?

Ans Types Of Radars

(a) **Primary Radar**. Uses the principle of pulse technique to determine range and bearing of an object. Working on echo and search light principle, a transmitter transmits pulses. All objects in the path of the pulses will reflect and scatter this energy. Some of the reflected energy reaches the receiver. The reflected energy is processed to give the required information. In this radar, the object's cooperation is not required in the entire process.

(b) **Secondary Radar**. A transmitter transmits a group of pulses. An aerial in the path of the pulses receives the signals and passes it to receiver. If the

pulses are identified, then the transmitter gives out a reply. In this radar active cooperation of the other object is also required.

(c) **Continuous Wave Radar**. In this type of radar, both the transmission and the reception take place continuously. This requires set of two aerials, one for transmission and one for reception.

CHAPTER 17

HISTORY OF AEROMODELLING

Q1. What are the aims of learning aero modelling?

Ans The aims of including aero modelling in the NCC curriculum are to increase the awareness about Air related issues in the youth of our country. The 'aero modelling' provides an earnest approach to the understanding of an otherwise highly technical subject, i.e. 'aerodynamics'. The 'air-minded' aero modeller of today is the potential aircraft designer of tomorrow

Q2. List the main materials used in aero modelling?

(a) Balsa Wood
(b) Spruce
(c) Japanica Wood
(d) Ply wood
(e) Cement
(f) Fast Setting Epoxy
(g) Cyanoacrylate Glue (Cyano)
(h) Putty
(i) Metal paste
(j) Dope
(k) Paint
(l) Sand paper
(m) Fibre glass
(n) Carbon fibre
(o) Silver Foil
(p) Monokote

Q3. List the basic tools used in aero modelling.

(a) Screw driver
(b) Hand drill
(c) Sand paper and pins
(d) Pliers
(e) Knives with different blades
(f) Different kind of saw
(g) Files
(h) Soldering irons
(i) RC set (Transmitter, Receiver, Servos) etc

TYPES OF AEROMODELS

Q4. How are aero-models classified?

Ans Aero-models are classified according to the role and utility of the particular type. These are static models, gliders, control line models and RC models.

Q5. What are the four different types of Aero-models?

Ans The four different types of Aero-Models are:-

(a) Static models
(b) Control line models
(c) Radio Control (RC) models
(d) Gliders

Q6. List the different types of gliders.

Ans The different types of gliders are:-

(a) Chuck Glider
(b) Catapult Glider
(c) Towline Glider
(d) Free flight Glider

Q7. List the different types of control line aero-models.

(a) Control Line Aerobatic Model
(b) Control Line Speed Model

Q8. List the different types of Radio Controlled aero-models.

(a) Radio Control Power
(b) Radio Control Glider
(c) Radio control Helicopter
(d) Jet Powered Model

Q9. Are there any limitations in flying an aero-model in the vicinity of an airport?

Ans Yes. The aero-model is not to be flown higher than approximately 400 feet within 3 miles of an airport without notifying the airport operator. An aero-model will give right of way to, and avoid flying in the proximity of full scale aircraft.

CHAPTER 18

FLYING/BUILDING OF AEROMODELS
CONSTRUCTIONS OF STATIC MODELS

Q1 What are the general safety codes to be followed in aero modelling flying?

Ans The following are the general safety code to be followed:-

(a) Not to fly model aircraft in competition or in the presence of spectators until it has been proven to be airworthy by having been previously successfully flight tested.

(b) Not to fly model aircraft higher than approximately 400 feet within 3 miles of an airport without notifying the airport operator.

(c) Give right of way to, and avoid flying in the proximity of full scale aircraft. Where necessary an observer shall be utilized to supervise flying to avoid having models fly in the proximity of full scale aircraft.

(d) Where established, abide by the safety rules for the flying site and willfully and deliberately not to fly my models in a careless, reckless, and/or dangerous manner.

Q2. What are the safety codes to be followed in RC flying?

Ans The following is the radio control safety code:-

(a) Not to fly model unless a successful radio equipment ground range check is completed before the first flight of a new or repaired model.

(b) Not to fly model aircraft in the presence of spectators until one is a qualified flyer, and assisted by an experienced helper.

(c) Perform initial turn after takeoff away from the pit, spectator, and parking areas, and will not thereafter perform manoeuvres, flights of any sort, or landing approaches over a pit, spectator, or parking area.