Introduction to Aeronautics

Introduction to Aeronautics and Airframe

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Kamal Darlami Hari Dura Sudip Bhattrai Aerospace Science and Engineering

Introduction to Aeronautics

Outline

1 Introduction to Aeronautics

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Aircraft and/or Airplane

Airplane

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Airplane is a word that is strictly to be used for fixed wing powered aircrafts and even rotator wing powered aircrafts such as helicopters are not included in the term airplane.

Aircraft Aircraft is a more generic word and includes all types of flying machines such as kites, balloons, airships, airplanes and helicopters etc.

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Spaceplane and/or Spacecraft

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Spaceplane

A vehicle that can fly as an aircraft close to earth and as a spacecraft in space.

Spacecraft

A vehicle designed for travel or operation in space beyond the earth’s atmosphere or in orbit around the earth.

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http://iss.astroviewer.net/

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The Wright Flyer

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The first successful controlled, powered and sustained heavier-than-air flight.

The Flyer lifted from level ground, at 10:35 a.m., on December17, 1903 at Kill Devil Hill, North Carolina.

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The Wright Flyer

Orville piloted the plane which weighed about 270 kg. The plane used railtracks for a guided launch, with a 12 horse power piston engine. The first attempt was made on 14th December with Wilbur willing the toss, but he pulled a sharp pitch which stalled the aircraft. Only minor damages incurred. The Orville flight lasted for 12 seconds, covering 36.5 m. They even build a wind-tunnel to test airfoil shapes that would give higher lift. The 1902 Wright Glider was the adopted design for Flyer.

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The Wright Gliders

Figure: WG 1901

Figure: WG 1902

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Wright Wind Tunnel

The (1901)

Wright Homemade Wind Tunnel

The Tunnel

Wright Flyer in a NASA Wind

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Wright Flyer

The Wright Flyer Configuration

Wright Military Flyer

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In 1905, Wilbur Wright piloted the Flyer III airplane for 39 minutes, covering a distance of about 40 km, till the plane ran out of fuel. Man kind could fly!

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Robert H. Goddard

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Founding Father of Modern Rocketry. He designed and built the first liquid-fueled rocket, carrying out a successful test on March 16, 1926 (US).

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Gliders-George Cayley

Known as Father of Gliders as well as Aerodynamics. Over the course of fifty years (between 1799 and the 1850s) he designed several variations of glider designs, carrying-out successful gravity assisted flights. Optimized wing shapes to achieve proper flow over it. Discovered the necessity of a tail for stability and acknowledged the need for carrying a propulsion system for power. Hence, identifying the four main forces acting on a flight vehicle, namely-lift, drag, thrust and weight (bodyforce).

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Gliders-Otto Lilienthal

Known as Glider King. By the time of his death he had achieved an unbeaten flight time of 5 hours with a total of 2500 flights. Gravity assisted glides against an upwash wind, his gliders were able to fly long distances (record of 250 m). He wrote a book on aerodynamics in 1989, which was used by Wright brothers as a basis for their design. Died after a glider test gone wrong in 1896. He fell 15 m with the glider, fracturing a vertebra. His last words were Sacrifices must be made!.

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Aerodome-Samuel P. Langley

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Acknowledged the necessity of generating power to achieve flight, and became the first inventor to use a propulsion system in a glider. Launched from a boat with a catapult, his first attempt on Oct. 7, 1903 ended with the Aerodome plunging into water, though an unmanned catapulted test in 1896 was a success (sort of; it ran out of fuel with in a mile). His second attempt, on December 8th 1903, the Aerodome crashed again nearly killing the pilot. It was the second public crash he faced within a few months. Depressed, disappointed and criticizedhe gave up!

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Hot-Air Balloons- Montgolfier Brothers

The French brothers, Joseph Michel and Jacques Etienne Montgolfier, were inventors of the first hot air balloon. The public demonstration was made on June 4th, 1783. It climbed to a height of about 1600-2000 m and traveled for about 10 minutes covering 2 km. In 1783, On the 19th of September 1783, theArostat Rveillonwas flown with living beings on it as a public demonstration. Thefirst passengersin the colorful balloon were a sheep, rooster and duck. It covered about 3 km in in 8 minutes, raising to an altitude of 460 m. Thefirst manned free flight was on Nov. 21, 1783.

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Airships- Zeppelin Company

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The concept has been around for long, since the 1670 flying boat concept of Francesco Lana de Terzi (Italian), but the German Zeppelin company pioneered the use of very large airships in the early 20th century.

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Airships- Zeppelin Company

Graf Zeppelin Intercontinental PassangerAirship.

They are known to be of three types: Rigid (has a structural framework), Semi-Rigid and Non-Rigid (shaped by internal pressure). They are also commonly referred to as Dirigibles, or simply as Zeppelin. Saw wide-spread military use in World-War I; they proved to be terrifying but highly inaccurate. The physical damage done by airships over the course of the war was insignificant, and the deaths that they caused amounted to a few hundred.

The Hindenburg disaster on May 6, 1937.

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Airships- Zeppelin Company

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The Ornithopter- Leonardo Da-Vinci

Da-Vincis Ornithopter Plan from 1490

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Other Honorable Attempts

William Henson

The Aerial Steam Carriage, conceived by William Henson in 1843, was the first aircraft design to show propellers.

Felix du Temple

In 1874, Felix du Temple made the first attempt at manned flight in a powered aircraft. He was not successful.

Thomas Walker

Thomas Walker,a portrait-painter from Hull, England publishes a pamphlet on the possibilities of fixed-wing aviation.

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Other Honorable Attempts

The oldest known attempt to describe a parachute is found in an anonymous depiction from 1470s Italy.

Franz Reichelt, a French tailor and inventor, designed a wearable parachute. With his parachute on, in February 4th 1912, he jumped from Eifel tower for a test and died.

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Timeline of Developments in Flight

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Commercial Aircraft:The First

The first commercial flight took place on January 1, 1914 aboard a Benoist XIV through a 21 km journey between two cities in US. The first commercial airliner was the Chalks

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First commercial Benoist XIV

flight aboard

International Airline in US. Founded in 1917, It ceased operation in 2007.

International Airline in US. Founded in 1917, It ceased operation in 2007.

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Commercial Aircraft:The Jetliner

First commercial jetliner was the 40-seater De Havilland DH 106 Comet, first flown on 27th June, 1949.

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Commercial Aircraft:Two Gaints

Airbus Boeing 707 first flew on 20 December

300 first flew on 28 October 1957

1972

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Commercial Aircraft:Two Gaints

Boeing 787 first flew on Dec. 15, 2009

Airbus 350 first flew on 14 June 2013

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Modern Aviation

Short Haul They have flight distance less than 3,200 km.

Airbus A320 Boeing 373 Canadair Jet Dash 8 etc

Long Haul

Airbus A330, Airbus A340 Airbus A350, Airbus A380 Boeing 747, Boeing 757 Boeing 767, Boeing 777, Boeing 787

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Supersonic Flight

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https://www.youtube.com/watch?v=gZ3-nEppy-k

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Supersonic Flight: Concorde

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In the 2000 accident, the jet slammed into a hotel near Paris’ Charles de Gaulle airport soon after taking off, killing all 109 people aboard and four others on the ground

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Experimental Ones

Electric Aircrafts

Supersonic Ones

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Boeing X-48B

Box Wing Jet

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Commercial Aircrafts: Manufacturer

Airbus Europe (France, Germany, Spain, Italy and UK). Boeing USA Bombardier Canada Embraer Brazil Tupolev Russian Beechcraft USA

Other countries such as China, Japan, Ukraine etc. has also started their manufacturing of commercial jets.

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Aircraft Engine: Manufacturer

Rolls-Royce: UK Pratt & Whitney: Canada GE Aviation: USA Safran: France Snecma: France MTU: Germany Mitsubishi Aircraft Corporation: Japan and many more......

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First Military Developments: First Jet

The worlds first aircraft to fly with a jet engine was the Heinkel He 178 experimental aircraft, built in Nazi Germany. It first flew on August 27, 1939.

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Variants: Military Aircraft

Combat Aircrafts

Fighter Aircrafts [E.g. F22, F35, Eurofighter, Su-57, J-20 etc.] Bomber Aircrafts [E.g. B-2, B-52, Tu-160, H-20 etc.] Attack Aircraft [E.g. A-10, Iiyushin II-2]

Non-Combat Aircrafts

Military Transport Aircraft [E.g. C-17, C-47 etc.] Reconnaissance and Surveillance Aircraft [E.g. SR-71, U-2 etc. ] Experimental Aircrafts [E.g. X-34, X-37, X-57 etc.]

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Rocketry: Military Developments

The German liquid-propelled rocket V-2 was the first application of rocket propulsion with a definite payload, the first long-range ballistic missile, and the first man-made object to reach suborbital altitudes and beyond( 180 km, 1944).

I have very deep and sincere regret for the victims of the V-2 rockets, but there were victims on both sides... A war is a war, and when my country is at war, my duty is to help win that war.” Kamal Darlami Hari Dura Sudip Bhattrai Aerospace Science and Engineering

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Wernher Von Braun

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Modern Aircraft: Supersonic Speed

The first aircraft to achieve flight at level supersonic speed was the rocket-powered Bell-X1 experimental aircraft. The record of fastest air-breathing manned aircraft is held by Lockheed SR-71.

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Modern Aircraft: Military Aircrafts

The official record for the highest speed achieved by a manned aircraft is held by the North American X-15 rocket-powered experimental aircraft at 7,271 km/hr. It also achieved two suborbital flights. It achieved hypersonic speed.

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Modern Aircraft: Military Aircrafts

The NASA X-43 experimental hypersonic aircraft (scramjet) has the highest speed record in horizontal flight at Mach 9.8 (Nov. 16, 2004). It had a burn time of approximately 10 seconds at an altitude of 33.5 km. The record for longest airbreathing hypersonic flight is held by Boeing X-51 (210s, May 2013). Kamal Darlami Hari Dura Sudip Bhattrai Aerospace Science and Engineering

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Airline Companies/Corporation in Nepal

Nepal Airlines Corporation (NAC) Himalayan Airlines Buddha Air Yeti Saurya Airlines Tara Air Shree Airlines etc

Nepal established its own airline with formation of Royal Nepal Airline Corporation in 1958 wih Douglas DC-3 Dakota aircraft.

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Aircraft used by Major Airlines in Nepal

Boeing [757 used by Nepal Airline Corporation (NAC)] Airbus [A320 currently used by NAC and Himalayan Airlines] Aerei da Trasporto Regionale (ATR) [ATR 42-300 currently used by Buddha and ATR 72-500 currently used by Buddha and Yeti] Bombardier CRJ200ER [currently used by Saurya Airlines] Beechcraft 1900D [Buddha Air]

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