



Fundamentals of Aeronautical Engineering

Grundlagen des Flugzeugbaus

Introduction

The course covers the fundamentals of the main disciplines of aeronautical engineering and their interdependencies. The disciplines covered are: Aerodynamics, flight mechanics, propulsion, aircraft systems, aircraft structures and aircraft design.

Goal

Participants shall obtain the capability to understand their specialized work task in the frame of the aviation system. They should see their work as part of the development cycle of an aircraft and should be able to relate their work to aeronautical fundamentals.

Course Structure

THE AVIATION SYSTEM

- Aviation politics
- Air traffic control (ATC)
- Airlines
- Airports
- Manufacturers and subcontractors

AERODYNAMICS

- Some basic definitions
- Airfoils
- Separation of flow
- Global loads on aircraft
- Lift
- Drag
- Stall
- Sonic waves
- Transonic regime
- Breaking the sound barrier
- Supersonic regime
- Supercritical wings
- Swept wing
- Wingtips
- Winglets
- Flight in Ground Effect
- Propeller

AIRCRAFT ENGINES

1. Basics
 - Propulsion
 - Thrust
 - Combustion
2. General classification of aircraft engines
3. Some history
4. Piston engines
5. Jet engines
 - 5.1 Thermojets
 - Turbojets
 - Components of a jet engine
 - Inlets
 - Compressor
 - Turbine
 - Burner
 - Nozzle
 - Afterburning jet thrust
 - Thrust reversing
 - 5.2 Turbofans
 - 5.3 Propfans
 - 5.4 Ramjets
 - 5.5 Scramjets

FLIGHT MECHANICS

1. International Standard Atmosphere (ISA)
2. Aircraft polar
3. Aircraft translation
4. Aircraft rotations
5. Flight controls
 - Main control surfaces: ailerons, elevators, rudder, elevons
 - Control surfaces: flaps, slats, flaperons, air brakes, spoilers
 - Secondary control surfaces
6. Basic flight evolutions
 - Horizontal flight, Climbing and Descending Flight
 - Banking turn
 - Maneuvers in vertical plane
 - Takeoff and landing
7. Critical flight regimes: the spin
8. Maximum flight time and endurance
9. The canard solution
10. V-tail
11. Aircraft stability (some notions)

AIRCRAFT STRUCTURES

1. Principles of stressed skin construction
 - Wood and canvas
 - All-metal aircrafts
 - Refractory and ablative materials
 - Typical design data for materials

2. Structure of a conventional aircraft
 - General principles
 - Wing and other aerodynamic surfaces
 - Fuselages
 - Fabrication of structural components:
 - wing and tail surfaces
 - fuselages
 - Gear configurations

3. Airworthiness and airframe loads
 - General principles
 - Loads, flight envelope
 - Cabin pressure
 - Fatigue
 - Safe life and fail-safe structures

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AIRCRAFT SYSTEMS

Aircraft Systems – The Airbus A321

- Air Conditioning (ATA 21)
- Auto Flight (ATA 22)
- Communication (ATA 23)
- Electrical Power (ATA 24)
- Equipment / Furnishings (ATA 25)
- Fire Protection (ATA 26)
- Flight Controls (ATA 27)
- Fuel (ATA 28)
- Hydraulic Power (ATA 29)
- Ice & Rain Protection (ATA 30)
- Indicating & Recording (ATA 31)
- Landing Gear (ATA 32)
- Lights (ATA 33)
- Navigation (ATA 34)
- Oxygen (ATA 35)
- Pneumatic (ATA 36)
- Water/Waste (ATA 38)
- Auxiliary Power (ATA 49)

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FUNDAMENTALS OF AIRCRAFT DESIGN

Lecturing includes:

- o **Lecture: Fundamentals of Aircraft Design**
- o Multi media presentation - From requirements to the 3-view-drawing
- o **Lecture Notes** (for more in depth coverage of the topic, for those who are interested):

- 1. Introduction
 - 2. Design Sequence
 - 3. Preliminary sizing
 - Introduction
 - Landing distance
 - Take-off distance
 - 2. segment climb rate
 - L/D estimation with landing gear and flaps
 - Missed approach climb rate
 - Cruise
 - Thrust-to-weight ratio
 - Wing loading
 - Maximum L/D estimation in cruise
 - Sizing diagram
 - Maximum take-off mass
 - Useful load
 - Fuel fractions
 - Take-off thrust and wing surface
 - 4. Literature
- o EXCEL-Sheet for Preliminary Sizing of Passenger Aircraft (Berechnungsschema zur Flugzeug-Dimensionierung)
<http://fe.ProfScholz.de>

"WÖRTERBUCH" zum Unterricht

Zum leichteren Verständnis der englischen Unterlagen wird den Teilnehmern ein kleines Luftfahrt-wörterbuch an die Hand gegeben, das speziell die Fach-Vokabeln enthält, die im Unterricht genutzt werden.

Point of Contact

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