**AEE 451 – Aeronautical Engineering Design I**
COURSE OUTLINE
Fall 2020-2021

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**Description:**

Conceptual design of fixed wing aircraft. Aircraft sizing. Airfoil and geometry selection. Thrust to weight ratio and wing loading. Configuration layout. Propulsion and fuel system integration. Landing gear and subsystems. Weights and balance. Stability, control and handling qualities. Performance and flight mechanics. Cost.

**Textbook**

- "Aircraft performance and design", Anderson, J.D., McGraw-Hill, 1999.

**Reference books:**

- "Aircraft Design: A Conceptual Approach", Raymer D.P., 6th Ed., AIAA Education Series, 2018 (older editions will also do).
- "The Design of The Airplane", Stinton D., Granada Publishing, 1983.
- "Airplane Design", Roskam J., Darcorporation, 1989.
- "Aeroplane Aerodynamics and Performance", Roskam J., Darcorporation, 1997.
- "Methods for Estimating Stability and Control Derivatives of Conventional Subsonic Aircraft", Roskam J.,
- "Dynamics of flight, stability and control", Etkin B. and Reid L.D., Wiley, 1996.
- "Fluid Dynamic Drag", Hoerner S.F., Hoerner Fluid Dynamics, 1965.
- "Sizing Matrix and Carpet Plots", Özgen S., *in Short Course on Small Aircraft and UAV Design,* Von Karman Institute Lecture Series, 2014.
- "Flight Safety, Airworthiness, Type Certificates, Design Requirements and Specifications", Özgen S., *in Short Course on Small Aircraft and UAV Design,* Von Karman Institute Lecture Series, 2014.
- Aviation Week & Space Technology, http://www.aviationweek.com

**Grading:**

1 midterm: 15 %
1 final: 25 %
Study assignments: 20 %
Project report: 25 %
Project presentation: 15 %

**Grading and course policy:**

- There will be only one make-up exam. It will be after the finals and it will cover everything. Try not to miss the exams!
- If you miss an exam you need to contact me within three days after the exam. You need a valid excuse (a medical certificate, etc.) for you to qualify for a make-up.
- Attendance is highly recommended.
- Study assignments are to be submitted on due date. Late submissions will not be accepted.
- The project groups must consist of maximum four people.
- Your work must be original. Duplications from past years or cheating will result in a 0 for your project grade. The same is true for study assignments.
- Please no bargaining for grades at the end of the semester.

**Course Outline:**

1. **The philosophy of airplane design**
   Phases of airplane design, pivot points for airplane design
2. **Requirements and competitor study for design**
   Customer requirements, airworthiness requirements, competitor analysis
3. **The weight of an airplane and its first estimate**
   Empty weight, fuel weight and maximum gross weight estimation
4. **Estimation of critical performance parameters**
   Maximum lift coefficient, wing loading, thrust to weight ratio, lift to drag ratio
5. **Geometry sizing & configuration layout**
   Overall configuration, wing configuration, fuselage configuration, center of gravity location, tail sizing, propeller and landing gear sizes
6. **Special considerations**
   Aerodynamic considerations, crew station, passengers, payload, external stores

7. **Propulsion and fuel system integration**
   Propulsion system options and integration, intakes, propellers, fuel system, types of fuel tanks

8. **Landing gear**
   Landing gear configurations, tyre sizing

9. **Aerodynamics**
   Lift, parasite drag, interference drag, wave drag, drag due to lift, component drag build-up

10. **Performance analysis**
    Power required and power available, rate of climb, stalling speed, maximum speed, range and endurance, landing and take-off distances, maneuverability.

11. **Flight Safety, Airworthiness, Type Certificates, Design Requirements and Specifications**
    Qualification and certification, airworthiness authorities, certification basis, acceptable means of compliance.