

UCK 451E, Principles of Aircraft Design, 2005-2006 Fall
Prof. Dr. Mehmet Şerif Kavsaoğlu

Course Outline

Introduction to Aircraft Design (3 hours)

Phases of aircraft design, aircraft conceptual design process Distribution and discussion of project assignments, explanation of reference materials, introductions to available software.

First Guess Sizing and Competitor Study (4.5 hours)

Takeoff weight buildup, empty weight estimation, fuel-fraction estimation, takeoff-weight calculation. Competitor study.

Airfoil and Geometry Selection (4.5 hours)

Airfoil selection, wing geometry, tail geometry and arrangement.

Thrust to Weight Ratio and Wing Loading (4.5 hours)

Thrust to weight ratio, wing loading, selection of thrust to weight and wing loading

Initial Sizing (4.5 hours)

Rubber Engine sizing, fixed engine sizing, geometry sizing, control surface sizing.

Configuration Layout and Loft (4.5 hours)

End products of configuration layout, conic lofting, conic fuselage development, flat-wrap fuselage lofting, circle to square adapter, fuselage loft verification, wing tail layout and loft, aircraft layout procedures, wetted area determination, volume determination, special considerations

Midterm Examination (3 hours)

Propulsion and Fuel System Integration (3 hours)

Propulsion selection, jet-engine integration, propeller-engine integration, fuel system

Landing Gear and Subsystems (3 hours)

Landing gear arrangements, tire sizing, shock absorbers, castoring wheel geometry, gear retraction geometry, seaplanes, subsystems

Aerodynamics (3 hours)

Lift, parasite drag, induced drag

Weights (1.5 hours)

Approximate group weights method, statistical group weights method

Stability, Control, and Handling Qualities (3 hours)

Longitudinal static stability and control, lateral directional static stability and control, stick free stability, effects of flexibility, dynamic stability, quasi-steady state, inertia coupling, handling qualities.

Performance and Flight Mechanics (Optional)

Steady level flight, steady climbing and descending flight, level turning flight, gliding flight, energy maneuverability methods, operating envelope, takeoff analysis, landing analysis.

Cost Analysis (Optional)

Elements of life cycle cost, cost estimating methods, RDT&E and production costs, operations and maintenance costs, military cost measures of merit, airline economics

Grading :

Midterm	: % 20 (Week of November 7)
Studies and Quiz	: % 20
Attendance	: % 5
Project	: % 35 (%15 during the semester + % 20 part of the final exam)
Final	: % 20

References:

- 1) Raymer D. P., "Aircraft Design: A Conceptual Approach", AIAA Education Series, 1992, ISBN: 0-930403-51-7
- 2) Roskam J., "Airplane Design", parts: 1-8, Roskam Aviation and Engineering Corporation, Rt 4, Box 274, Ottawa, Kansas, 66067 USA
- 3) Torenbeek E., "Synthesis of Subsonic Airplane Design", Delft University Press, Netherlands, 1976, 1979, ISBN: 90-298-25057.
- 4) Nikolai, L. M., "Fundamentals of Aircraft Design", METS, California, 1979, METS Inc., 6520 Kingsland Court, San Jose, CA 95210, U.S.A.
- 5) Jenkinson L. R., Simpkin P., Rhodes D., "Civil Jet Aircraft Design", Arnold, 1999, ISBN: 0 340 74152X.
- 6) Lan C. E., Roskam Jan, "Airplane Aerodynamics and Performance", Roskam Aviation and Engineering Corporation, Rt 4, Box 274, Ottawa, Kansas, 66067 U.S.A.
- 7) Roskam J., "Airplane Flight Dynamics and Automatic Flight Controls", Parts 1 and 2, Roskam Aviation and Engineering Corporation, Rt 4, Box 274, Ottawa, Kansas, 66067 U.S.A., 1982, Library of Congress Catalog Card Number: 80-6308.
- 8) "Jane's All the World's Aircraft", Jane's Information Group, Sentinel House, 163 Brighton Road, Coulsdon, Surrey CR5 2NH, UK, ISBN for 1991-1992 issue: 0 7106 0965 5.
- 9) "Code of Federal Regulations- Aeronautics and Space, Title: 14, parts 1-59", revised as of January 1990, published by the Office of the Federal Register National Archives and the Records Administration as a special edition of the Federal Register, U.S. Government Printing Office, Washington 1990, For sale by the Superintendent of the Documents, U.S. Government Printing Office, Washington D.C. 20402, U.S.A.
- 10) "Flight International", weekly periodical, published by the Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS, England, ISSN: 0015-3710.
- 11) Hoak, D., Ellison D., et al., "USAF DATCOM", Air Force Flight Dynamics Lab., Wright Patterson AFB, OH, U.S.A.
- 12) Abbott, I. R., Von Doenhoff, A. E., "Theory of Wing Sections", Dover Publications Inc., New York, 1949, 1959. ISBN: 0-486-60586-8.
- 13) Riegels, F. W., "Aerofoil Sections", Butterworths, London, 1961.
- 14) Eppler, R., "Airfoil Design and Data", Springer Verlag, 1990, ISBN : 0-387-52505-X, ISBN : 0-540-52505-X.
- 15) McGhee, R. J., Beasley, W. D., "Low Speed Aerodynamic Characteristics of a 17-Percent-Thick Airfoil Section Designed For General Aviation Applications", NASA TN D-7428, December 1973.

HOW TO LEARN?

- Read the chapter before the lecture
- Attend to the lecture
- Read the chapter before the study
- Start the chapter study in the study hour, ask questions
- Complete the chapter study at home and prepare the study report
- Correct and combine the study reports and prepare the final project report.