AERONAUTICAL ENGINEERING MAJOR

Suggested Course Sequence:

3rd-Class Year	2nd-Class Year	1st-Class Year
Aero Engr 210/315	Aero Engr 341	Academy Option A. E. Elective
Chem 200	Aero Engr 342	Aero Design Elective
Econ 201	Aero Engr 351	Aero Engr 442
ECE 231	Aero Engr 352	Aero Engr 471
Engr Mech 220	Aero Engr 361	Aero Engr 481
Law 220	Beh Sci 310	Astro Engr 310
Math 243	English 211	Biology 315
Math 245	Engr Mech 320	English 411
MSS 200	Engr Mech 330	Engr Mech 332
Physics 215	History 300	MSS 415
Pol Sci 211	Math 346	Philos 310
Sys Opt Aero Engr 241	Math 356	Soc Sci 412

AERONAUTICS (Aero Engr)

Offered by the Department of Aeronautics (DFAN).

Aero Engr 210. Fundamentals of Aeronautics. Introduces aircraft design, fluid mechanics, airfoil and wing aerodynamics, steady and accelerated aircraft performance, with special emphasis on computer programming using Mat Lab. Interdisciplinary design synthesis, analysis, and decision-making (including economic, political, and other non-technical considerations) of an aircraft to meet a contemporary requirement. Is intended for cadets who have declared or are considering declaring a major in Aero Engr.

Aero Engr 241. Aero-Thermodynamics. Fundamentals of the 1st and 2nd laws of thermodynamics applied to systems and control volumes. Foundations in heat transfer. Control volume approaches to the equations of motion of a fluid. Applications of gas dynamics to incompressible and compressible flows through nozzles, diffusers and turbomachinery. Isentropic flows to include Prandtl-Meyer expansions, and non-isentropic flows to include normal and oblique shocks, and flows with simple friction and heat transfer. Foundations in engineering problem solving.

Aero Engr 315. Fundamentals of Aeronautics. Introduction to aircraft design, fluid mechanics, airfoil and wing aerodynamics, steady and accelerated aircraft performance, and stability and control. Interdisciplinary design synthesis, analysis and decision-making (including economic, political and other non-technical considerations) of an aircraft to meet a contemporary requirement.

Aero Engr 315Z. Fundamentals of Aeronautics – French language section. Section taught in French; available for students qualified for Aero Engr 315 and having successfully completed or validated French 321; counts as a course for the French language minor and for a major's foreign language requirement. Requires DFF approval.

Aero Engr 341. Aeronautical Fluid Dynamics. Fluid properties, the basic equations of motion: the continuity equation, conservation of linear momentum, and conservation of energy (both the differential and the integral forms). Use of the integral momentum equation to experimentally determine the drag acting on a cylinder in a low-speed stream; spread-sheet computation of unsteady Poiseuille flow; spread-sheet computation of a steady, laminar boundary-layer; turbulent boundary layer experiment. Stream functions. Potential functions.

Aero Engr 342. Computational Aerodynamics. This course covers the theory and application of modern computational tools used to predict fluid flows around basic and complex geometries. The course is intended to give the student the necessary knowledge to choose the relevant computational tool and perform independent computational analysis of moderately complex geometries. The course will cover grid generation, computational fluid dynamic (CFD) solvers, and post processing using state-of-the-art tools, as well as computational potential methods such as panel codes or vortex lattice codes. The course is project-oriented and explores the important concepts of temporal and spatial resolution, stability and convergence, and flow-field analysis.

Aero Engr 351. Aircraft Performance and Static Stability. Aircraft force, moment and response definition in various coordinate systems. Takeoff and landing, cruise, climbs, turns and other accelerated performance by both analytic and numerical methods. Static stability and control and related aircraft design considerations.

Aero Engr 352. Aircraft Dynamic Stability and Control. Aircraft equations of motion. Examination of aircraft dynamic modes based on both limited and full degree of freedom models utilizing analytical and numerical methods. Aircraft design considerations. Determination and evaluation of aircraft flying qualities against military specifications. Application of control system theory to the design of aircraft stability augmentation systems and autopilots.

Aero Engr 361. Propulsion I. Introduction to Brayton and jet engine cycles. Application of aero-thermodynamics to aircraft jet engines and major engine components. Overview of the design, performance and applications of turboprops/shafts, turbofans, turbojets, ramjets and scramjets and rockets. Focus on preliminary cycle analysis of aircraft gas turbine engines to include mission analysis, parametric cycle analysis and engine performance analysis.

Aero Engr 436. Aeroelasticity. Aeroelastic phenomena of an aircraft in flight. Dynamic pressure, Mach and angle of attack effects on the bending and twisting of aircraft components. Aeroelastic equations and coefficients related to flight characteristics such as flutter and divergence.

Aero Engr 442. Advanced Aerodynamics. Analytical and numerical solution techniques applied to incompressible, compressible, transonic and supersonic flight regimes over airfoils, wings and bodies. Introduction to hypersonic aerodynamics. Techniques include those historically used in incompressible flow up to and including state-of-the-art supersonic solutions using high speed computers.

Aero Engr 446. Introduction to Hypersonics. Analysis of heat transfer and high temperature effects on hypersonic vehicles. Application to reentry and transatmospheric vehicles.

Aero Engr 447. Advanced Applied Aerodynamics. Considers advanced topics in steady and unsteady aerodynamics in all speed ranges for study by analytical, experimental and computational methods.

Aero Engr 456. Flight Test Techniques. Fundamental flight test methods for defining performance and flying qualities characteristic of fixed wing aircraft. Patterned after the Flight Test Engineer's Course at the Air Force Test Pilot School. Students fly in designated aircraft to obtain flight test data.

Aero Engr 456L. Flight Test Techniques Laboratory. Application of fundamental flight test methods for defining the performance and flying qualities characteristic of high performance fixed wing aircraft. This laboratory experience serves as a final project for Aero Engr 456. Students receive credit by participating in a field trip to

Edwards AFB, a flight test sortie in a high performance aircraft, creation of a written report, and presentation of a final briefing. Scheduled during the same class period as Aero Engr 456.

Aero Engr 457. Aircraft Feedback Control Systems. Design and analysis of aircraft stability augmentation and automatic flight control systems by classical root locus and frequency domain techniques. Introduction to digital system analysis. Analytical and numerical methods complemented with aircraft simulation.

Aero Engr 466. Propulsion II. Analysis of advanced aircraft engines. Preliminary aerodynamic and structural design of major engine components including inlets, compressors, combustors, turbines, mixers, afterburners and nozzles.

Aero Engr 471. Aeronautics Laboratory. Introduction to experimental methods and techniques. Introduction to instrumentation and data acquisition systems. Statistical analysis of data. Selected experiments in the fields of aerodynamics, gas dynamics, propulsion and flight mechanics.

Aero Engr 472. Advanced Computational Aerodynamics. Advanced theory and application of computational tools used to predict and analyze fluid flows of interest supporting Air Force research, development, test and evaluation programs. Working in teams, students gain the necessary knowledge and background to make contributions using the DOD's High Performance Computing (HPC) Modernization Program resources. Projects include investigation of unsteady flows, boundary layers, turbulence models, shocks and multi-physics simulations.

Aero Engr 481. Introduction to Aircraft and Propulsion System Design. Fundamentals of aircraft and propulsion system design taught using a systems engineering approach. Aerodynamic design and drag prediction. Parameter effects on constraint analyses and preliminary weight estimation. Configuration optimization. Conceptual layout and preliminary analysis of aircraft structures. Factor and margin of safety. Material selection including strength, stiffness, weight and cost considerations. Introduction to propulsion system design and selection criteria. Safety, reliability, maintainability, schedule and cost management concerns are addressed.

Aero Engr 482. Aircraft Design. Design of an aircraft using a systems engineering approach to meet specifications provided. Detailed configuration optimization, aerodynamic analysis, structural layout, material selection, and structural component sizing, weight and center of gravity analysis, and stability and control analysis. Safety, reliability, maintainability, schedule and cost management concerns are addressed.

Aero Engr 483. Aircraft Engine Design. Preliminary design of an aircraft engine to meet specified performance requirements. Cycle selection, installation effects and engine sizing. Determination of installed and uninstalled performance of selected and sized engine. Preliminary design of major engine components to include variable geometry inlets, fans, compressor, main burner, turbine, afterburner and exhaust nozzles. Material selection for each component is accomplished based on criteria such as the stress and temperature environments, manufacturability, radar absorption capability, weight, and cost. Safety, reliability and maintainability concerns during the design process are addressed throughout the course. Course includes, if possible, a voluntary field trip to a government/industry design facility.

Aero Engr 495. Special Topics. Selected topics in aeronautical engineering.

Aero Engr 499. Independent Study. Individual study and research supervised by a faculty member. Topic established with the department head.