Aerospace Engineering Technical Elective Courses

ARO 328 - Aerospace Structures (4)


Prerequisite(s): C or better in ARO 329.
Component(s): 4 lectures/problem-solving.

ARO 332/332L - Sensing, Data Acquisition, and Control (3/1)

Understanding the basic principles associated with practical applications of sensing, data acquisition and controls. It provides an overview of signals, electronic components, circuitry, and software and how such elements are integrated and used to bridge the human understanding between engineering theory, engineering practice, and engineering observation.

Prerequisite(s): ECE 114/ECE 114L; MAT 216 or MAT 224; and PHY 133/PHY 133L, or with the consent of the instructor.
Component(s): 3 lectures/problem-solving, 1 three-hour laboratory.

ARO 342L - Space Vehicle Dynamics & Propulsion Laboratory (1)

Selected experiments in space vehicle dynamics and propulsion using computer-based data acquisition methods. Gyroscope dynamics, control-moment gyro, solid-fuel rocket motors, strain gages, static test stand, filtering, data analysis. Teamwork. Technical communication and engineering report writing.

Prerequisite(s): Minimum grade of C (2.0) or better in ARO 309 and ARO 406.
Component(s): 1 three-hour laboratory.
ARO 352L - High-Speed Aerodynamics Laboratory (1)

Selected experiments in high-speed aerodynamics using a supersonic wind tunnel and a computer-based data acquisition system. Team work. Laboratory report writing.

Prerequisite(s): C or better in ARO 404.
Component(s): 1 three-hour laboratory.

ARO 402 - Numerical Methods (4)

Numerical methods in engineering including: algorithms development, solving nonlinear equations, solving linear systems, difference formulas, numerical differentiation and integration, with applications to aerospace engineering problems.

Prerequisite(s): C or better in MAT 216 or MAT 224.
Component(s): 4 lectures/problem-solving.

ARO 407 - Space Flight Dynamics (4)


Prerequisite(s): C or better in ARO 406.
Component(s): 4 lectures/problem-solving.

ARO 408 - Finite-Element Analysis of Aerospace Structures (4)

Theoretical development of one- and two-dimensional finite elements. Analysis and design of truss, frame and semimonocoque structures using the direct stiffness and energy formulation of the finite element method. Computer-aided design and analysis projects using commercial finite element software.

Prerequisite(s): C or better in ARO 326/326L (lecture component only).
Component(s): 4 lectures/problem-solving.
ARO 409 - Spacecraft Dynamics and Control (4)


Prerequisite(s): C or better in ARO 309, ARO 406.
Component(s): 4 lectures/problem-solving.

ARO 412 - Wing Theory (4)


Prerequisite(s): C or better in ARO 305.
Component(s): 4 lectures/problem-solving.

ARO 414 - Rocket Propulsion (4)


Prerequisite(s): C or better in ARO 103L and ARO 311.
Component(s): 4 lectures/problem-solving.

ARO 418 - Space Environment (4)

The space environment and its impact on spacecraft operations. Non-uniform gravitational fields, aerodynamic drag effects including aerobraking, solar heating and pressure, radiation, electrical issues, orbital debris. Considerations for special orbits. On-board disturbances. Spacecraft thermal control, life support systems.

Prerequisite(s): C or better in ARO 309.
Component(s): 4 lectures/ problem-solving.
ARO 419 - Computational Fluid Dynamics (4)


Prerequisite(s): C or better in ARO 301.
Corequisite(s): ARO 311.
Component(s): 4 lectures/problem-solving.

ARO 420 - Aerospace Engineering Management (4)

Introduction to various management roles in technical fields. Gain insight into the roles of Program Management, Project Management and Functional Management in aerospace companies. Understand government agencies and customer interactions. Role of discretionary R&D and proposal development. Career path development and expected skills requirements. Program Management Plan; team project linked to ARO 471L/ARO 481L/ARO 491L, ARO 472L/ARO 482L/ARO 492L, and ARO 473L/ARO 483L/ARO 493L.

Prerequisite(s): C or better in ARO 201L.
Corequisite(s): ARO 471L, ARO 481L, or ARO 491L.
Component(s): 4 lectures/problem-solving.

ARO 421 - Helicopter Aerodynamics and Performance (4)

The development of rotary-wing aircraft and the helicopter. Review of blade element/momentum theory; hovering and vertical flight theory; autorotation; performance in forward flight.

Prerequisite(s): C or better in ARO 405.
Component(s): 4 lectures/problem-solving.
ARO 422 - Robust Control of Nonlinear Systems (4)


Prerequisite(s): C or better in ARO 322/322L or equivalent.
Component(s): 4 lectures/problem-solving.

ARO 426 - Aerospace Surface Systems (4)


Prerequisite(s): C or better in ARO 305.
Component(s): 4 lectures/problem solving.

ARO 427 - Aeroacoustics and Structural Dynamics (4)

Vibrational concepts of acoustics: time and frequency domain analysis, free and forced motion of single and multi-degree of freedom systems, random inputs, and approximation methods. Classical vibration control. Structural wave motion: aeroelasticity, divergence, and flutter.

Prerequisite(s): C or better in ARO 327 and ME 215.
Component(s): 4 lectures.

ARO 431 - Intermediate Finite-Element Analysis of Aerospace Structures (4)

Structural dynamics, structural stability and advanced elements in the finite element method. Basic theory will be augmented strongly by computer applications.

Prerequisite(s): C or better in ARO 408.
Component(s): 4 lectures/problem-solving.
ARO 433 - Digital Flight Control Systems (4)

Discrete time systems, difference equations, Z-transform theory, sampled data systems, mathematical modeling of sampled data systems, data reconstruction, analysis of discrete systems, transient and steady-state specifications, state estimation, controllability, observability, design of digital control systems, PID controllers, phase-lead and phase-lag designs, application to flight control systems.

Prerequisite(s): C or better in ARO 322/322L (lecture component only) or equivalent.
Component(s): 4 lectures/problem-solving.

ARO 435L - Low-Speed Aerodynamics Laboratory (1)

Test plan formulation. Pressure, temperature and loads measurements. Test section calibration and correction. Subsonic wind tunnel applications.

Prerequisite(s): C or better in ARO 305.
Component(s): 1 three-hour laboratories.

ARO 436 - Mechanics of Composite Materials (4)


Prerequisite(s): C or better in ARO 327.
Component(s): 4 lectures/problem-solving.

ARO 443 - Aircraft System Identification (4)


Prerequisite(s): C or better in ARO 405 and consent of instructor.
Component(s): 4 lectures/problem-solving.
ARO 445 - Applied Optimal Control (4)

Introduction to optimal control, linear quadratic regulator (LQR), algebraic Riccati equation, controllability, observability, detectability, and stabilizability, design of multi-input/multi-output controllers, advance control techniques and advanced control structures, application to flight control systems.

Prerequisite(s): C or better in ARO 322/322L or equivalent.
Component(s): 4 lectures/problem solving.

ARO 446 - Orbit Determination and Estimation (4)

A brief review of two-body dynamics and space environment; fundamentals of probability and statistics; introduction to orbit problem and fundamentals of orbit determination concept; observation techniques and models; orbit determination techniques: the least squares solution, the minimum variance estimate, maximum likelihood and Bayesian estimation, batch and sequential Estimation, and the Gauss-Markov process.

Prerequisite(s): C or better in MAT 216 (or MAT 224) and ARO 309, or with instructor consent.
Component(s): 4 lectures/problem-solving.

ARO 451 - Model-Based System Architecture (4)

Describe various architecture frameworks (primarily DODAF). Understand customer needs by building discrete-event operational models. Use operational models to elicit system external and human interfaces. Derive system states and modes. Develop re-useable functional system architectures and derive performance requirements. Define physical system architectures that implement functions and meet performance requirements. Design Analysis Cycles. Trade study definition relative to architecture models. Drive safety assessment from operational, functional, and physical system models.

Prerequisite(s): C or better in ARO 201L.
Component(s): 4 lectures/problem-solving.