A E-AEROSPACE ENGINEERING

A E 339. Aerodynamics I
3 Credits (3)
Fluid properties, conservation equations, incompressible 2-dimensional flow; Bernoulli's equation; similarity parameters; subsonic aerodynamics: lift and drag, analysis and design of airfoils. May be repeated up to 3 credits.
Prerequisite: C- or better grades in ENGR 234 and (M E 228 or MATH 392).
Learning Outcomes
1. Ability to apply knowledge of mathematics, science, and engineering;
2. Ability to design and conduct experiments, as well as to analyze and interpret data;
3. Ability to design a system, component or process to meet desired needs within realistic constraints;
4. Ability to identify, formulate, and solve engineering problems.

A E 362. Orbital Mechanics
3 Credits (3)
Dynamics of exoatmospheric flight of orbiting and non-orbiting bodies; 2-body orbital dynamics and Kepler's laws; orbits in 3 dimensions; orbit determination; orbit design and orbital maneuvers; lunar and interplanetary trajectories. May be repeated up to 3 credits.
Prerequisite: C- or better grades in (M E 228 or MATH 392), ENGR 234, and M E 261.
Learning Outcomes
1. Ability to apply knowledge of mathematics, science, and engineering;
2. Ability to identify, formulate, and solve engineering problems;
3. Ability to use the techniques, skills and modern tools necessary for engineering practice.

A E 363. Aerospace Structures
3 Credits (3)
Advanced concepts of stress and strain, introduction to the analysis of aero structures, complex bending and torsion, thin walled sections and shells, computational techniques. May be repeated up to 3 credits.
Prerequisite: C- or better grades in C E 301.
Learning Outcomes
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

A E 364. Flight Dynamics and Controls
3 Credits (3)
Fundamentals of airplane flight dynamics, static trim, and stability; spacecraft and missile six degree of freedom dynamics; attitude control of spacecraft. May be repeated up to 3 credits.
Prerequisite: C- or better grades in (M E 228 or MATH 392), ENGR 234, and M E 261.
Learning Outcomes
1. Ability to apply knowledge of mathematics, science, and engineering;
2. Ability to identify, formulate, and solve engineering problems;
3. Ability to use the techniques, skills and modern tools necessary for engineering practice.

A E 400. Undergraduate Research
1-3 Credits (1-3)
Performed with the direction of a department faculty member. May be repeated for a maximum of 6 credits.
Prerequisite(s): Consent of faculty member.

A E 405. Special Topics
3 Credits (3)
Topics of modern interest to be offered by the departmental staff. Consent of instructor required.

A E 419. Propulsion
3 Credits (3)
Propulsion systems, thermodynamic cycles, combustion, specific impulse; principles of gas turbines, jet engines, and rocket propulsion systems. May be repeated up to 3 credits.
Prerequisite: C- or better grades in A E 439.
Learning Outcomes
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

A E 424. Aerospace Systems Engineering
3 Credits (3)
Basic principles of top down systems engineering and current practice; preliminary and detailed design of aircraft and space vehicles, including requirement, subsystem interaction, and integration, tradeoffs, constraints and non-technical aspects. May be repeated up to 3 credits.
Prerequisite: C- or better grades in A E 362.
Learning Outcomes
1. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
2. an ability to communicate effectively with a range of audiences
3. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
4. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

A E 428. Aerospace Capstone Design
3 Credits (3+2P)
Team Project-analysis, design, hands-on build test, evaluate.
Prerequisite(s)/Corequisite(s): A E 447. Prerequisite(s): A E 363 and A E 424.

A E 439. Aerodynamics II
3 Credits (3)
Principles of compressible flow, momentum and energy conservation; thermal properties of fluids; supersonic flow and shock waves; basics of supersonic aerodynamics. May be repeated up to 3 credits.
Prerequisite: C- or better grades in (A E 339 or M E 338), M E 240, and (M E 328 or PHYS 395).
Learning Outcomes
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

A E 447. Aerofluids Laboratory
3 Credits (2+3P)
Use of subsonic wind tunnels and other flow to study basic flow phenomena and methods of fluid measurement and visualization. May be repeated up to 3 credits.

Prerequisite: M E 345 or PHYS 325.
Prerequisite/Corequisite: A E 439.
Learning Outcomes
1. Students will be able to write technical reports about aerodynamic experiments and make oral presentations, being familiar with data acquisition, processing and visualization.

A E 451. Aircraft Design
3 Credits (3)
Conceptual design of aircraft based on existing designs, empirical relationships, and theory. Dimensioning, structural design, and performance analysis of major subcomponents such as fuselage, wing, and propulsion system. Static stability and control analysis.
Prerequisite(s): A E 339 and A E 363.

A E 452. Control System Design
3 Credits (3)
Introduction to the control of dynamical systems, with a focus on mechanical and aerospace systems, including basic systems theory, controllability / observability, feedback and stabilization, PID controls, root-locus plot, and Bode diagram. May be repeated up to 3 credits.
Prerequisite: M E 261, M E 328 and ENGR 234.
Learning Outcomes
1. Construct a block diagram to find a transfer function for a dynamical system;
2. Analyze control systems by utilizing various linear control theories such as root-locus design method, bode / Nyquist plots, and lead / lag compensation techniques;
3. Design and simulate automatic control systems for mechanical and aerospace engineering applications.

A E 464. Advanced Flight Dynamics and Controls
3 Credits (3)
Advanced airplane flight dynamics and stability control system design, longitudinal and lateral autopilots, missile/rocket control systems, and guidance systems.
Prerequisite(s): A E 364 or consent of instructor.

A E 509. Individualized Study
3 Credits (3)
Individualized study covering specialized topics in aerospace engineering. Consent of instructor required. Restricted to A E & M E majors.

A E 510. Special Topics
1-6 Credits (1-6)
Topics in aerospace engineering. May be repeated for a maximum of 6 credits. Consent of instructor required.

A E 527. Linear Systems Theory
3 Credits (3)
Introduction to control of linear multi-input-multi-output (MIMO) systems. Topics include representation of system dynamics using the state-space model, linearization, internal and input-to-output stability, controllability, observability, optimal control, linear quadratic regulator, and observer. May be repeated up to 3 credits.
Learning Outcomes
1. Students are able to design linear multi-input-multi-output (MIMO) control systems.

A E 533. Numerical Methods for Fluid Mechanics and Heat Transfer
3 Credits (3)
Numerical methods for solving differential equations (initial and boundary value problems, eigenvalue problems) with focus on fluid mechanics and heat transfer problems. Concepts such as stability, accuracy, consistency, and systematic errors (phase/amplitude error). Implement and test algorithms for the solution of ordinary and partial differential equations. May be repeated up to 3 credits.
Prerequisite: M E 341.
Learning Outcomes
1. An ability to apply computational approaches to fluid dynamic and heat transfer problems and to understand limitations with respect to stability, accuracy, and error.

A E 564. Advanced Flight Dynamics and Controls
3 Credits (3)
Advanced airplane flight dynamics and stability control system design, longitudinal and lateral autopilots, missile / rocket control systems, and guidance systems May be repeated up to 3 credits.
Prerequisite(s): A E 364 or consent of instructor.

A E 598. Special Research Programs
1-3 Credits (1-3)
Individual investigations, either analytical or experimental. May be repeated for a maximum of 6 credits. Restricted to A E & M E majors.

A E 599. Master's Thesis
1-15 Credits (1-15)
Thesis. Graded: Thesis/Dissertation.

A E 600. Doctoral Research
1-15 Credits (1-15)
This course number is used for assigning credit for research performed prior to successful completion of the doctoral qualifying examination. Graded: Thesis/Dissertation.

A E 700. Doctoral Dissertation
15 Credits (15)
Dissertation. Graded: Thesis/Dissertation.