

ENAE - ENGINEERING, AEROSPACE

ENAE100 The Aerospace Engineering Profession (1 Credit)

Overview of salient aspects of professional practice of Aerospace Engineering. Introduction to the range of technical expertise needed to succeed in the profession and the objectives of the various parts of the Aerospace Engineering program at UMCP in supporting students' efforts in gaining the required knowledge and skills. Familiarization with departmental faculty and their areas of research, creation of links with other students, professional society student chapters, and available resources. Discussion of ethical issues, business requirements, and their interactions with technical developments.

Recommended: ENES100 and MATH140.

ENAE200 Aerospace Engineering Profession II (1 Credit)

Overview of the engineering profession as it pertains to the role of the engineer in society, professional practice and ethical standards, career development, opportunities and need for lifelong learning, importance of safety and standards, effective written, visual, and oral communications, and the impact of the engineering profession on global issues.

Recommended: ENAE100.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE202 Computing Fundamentals for Engineers (3 Credits)

Introduction to computational tools for the solution of engineering problems. C++ & MATLAB programming including branching and loops, functions, file handling, arrays, and data structures. Students will be introduced to object-oriented programming, basic computing, algorithms, and principles of software engineering.

Credit Only Granted for: ENAE202 or ENME202.

ENAE283 Introduction to Aerospace Systems (3 Credits)

Introduction to airplanes and space vehicles as aerospace systems. Fundamentals that describe these systems. Elements of aerodynamics, airfoils and wings. Airplane performance, stability and control. Aircraft and rocket propulsion. Fundamentals of orbital motion. Aspects of vehicle conceptual design.

Prerequisite: PHYS161, MATH141, and ENES102.

Corequisite: PHYS261 and PHYS260.

Restriction: Must be in Engineering: Aerospace program.

Credit Only Granted for: (ENAE281 and ENAE282) or ENAE283.

Formerly: ENAE281 and ENAE282.

ENAE301 Dynamics of Aerospace Systems (3 Credits)

Kinematics and dynamics of three dimensional motion of point masses and rigid bodies with introduction to more general systems. Primary emphasis on Newtonian methods. Practice in numerical solutions and computer animation of equations of motion using MATLAB.

Prerequisite: PHYS271, MATH461, PHYS270, MATH246, ENAE283, ENAE202, ENES102, and MATH241.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE311 Compressible Aerodynamics (3 Credits)

Fundamentals of aerodynamics. Elements of compressible flow. Normal and oblique shock waves. Flows through nozzles, diffusers and wind tunnels. Elements of the method of characteristics and finite difference solutions for compressible flows. Aspects of hypersonic flow.

Prerequisite: PHYS271, (MATH240 or MATH461), PHYS270, MATH246, ENAE283, ENES220, ENAE202, MATH241, and ENES232.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department; and junior standing or higher.

ENAE324 Aerospace Structures (4 Credits)

Analysis of torsion, beam bending, plate bending, buckling and their application to aerospace.

Prerequisite: ENES220.

Restriction: Must be in Engineering: Aerospace program.

ENAE362 Aerospace Instrumentation and Experimentation (3 Credits)

Basic instrumentation electronics including DC electronics, AC electronics, semiconductors, electro-optics and digital electronics. Sensing devices used to carry out experiments in Aerospace Engineering includes metrology, machine tool measurements, bridge circuits, optical devices, and introduction to computer based data acquisition. Topics chosen to support measurements in aerodynamics, flight structures and flight control.

Prerequisite: MATH246 and ENAE283.

Restriction: Must be in Engineering: Aerospace program; and junior standing or higher.

ENAE380 Flight Software Systems (3 Credits)

Avionics using advanced sensor and computing technologies are at the heart of every modern Aerospace vehicle. Advanced software systems to improve cockpit safety and enable unmanned and deep-space missions. Object-oriented programming and software engineering concepts required to design and build complex flight software systems. Software validation, verification and real-time performance analysis to assess flight software system reliability and robustness. Human-machine interface design for piloted systems. Automatic onboard data acquisition and decision-making for unmanned air and space vehicles.

Prerequisite: ENAE283 and ENAE202.

Restriction: Must be in Engineering: Aerospace program; and junior standing or higher.

ENAE398 Honors Research Project (1-3 Credits)

Planned sequence of steps in aerospace honors research in which students take three (3) consecutive semesters of this course in partial fulfillment of aerospace engineering honors program requirements. The first semester consists of a series of seminars and meetings with faculty mentors on honors research; two semesters consist of undergraduate honors research project and paper conducted under the direction of an aerospace engineering faculty member to be presented at a conference.

Prerequisite: Must be accepted into Aerospace Honors Program.

Restriction: Must be in Engineering: Aerospace program.

Repeatable to: 3 credits if content differs.

ENAE403 Aircraft Flight Dynamics (3 Credits)

Study of motion of aircraft, equations of motion, aerodynamic force representation, longitudinal and lateral motions, response to controls and to atmospheric disturbances, handling qualities criteria and other figures of merit.

Prerequisite: ENAE414 and ENAE432.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE404 Space Flight Dynamics (3 Credits)

Three-dimensional motion under central fields. Solutions to orbital motion, orbital elements, time elements. Kepler's laws. Orbital maneuvering, rendezvous and station-keeping. Rigid-body attitude dynamics, spacecraft attitude dynamics.

Prerequisite: ENAE301.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE414 Incompressible Aerodynamics (3 Credits)

Aerodynamics of inviscid incompressible flows. Aerodynamic forces and moments. Fluid statics/buoyancy force. Vorticity, circulation, the stream function and the velocity potential. Bernoulli's and Laplace's equations. Flows in low speed wind tunnels and airspeed measurement. Potential flows involving sources and sinks, doublets, and vortices. Development of the theory of airfoils and wings.

Prerequisite: PHYS271, (MATH240 or MATH461), PHYS270, MATH246, ENAE283, ENES220, ENAE202, MATH241, and ENES232.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department; and junior standing or higher.

ENAE415 Helicopter Theory (3 Credits)

Elementary exposition on the theory and practice of aerodynamics applied to helicopters and other rotary wing aircraft.

Prerequisite: ENAE414.

Restriction: Must be in Engineering: Aerospace program.

ENAE420 Computational Structural Mechanics (3 Credits)

Introductory of finite element methods for aerospace engineering modeling and analysis; equips students with ability to understand manuals of commercial finite element analysis software.

Prerequisite: ENES220 and MATH241; and must have completed a course in linear algebra.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE423 Vibration and Aeroelasticity (3 Credits)

Dynamic response of single and multiple degrees of freedom systems, finite element modeling, wing divergence, aileron reversal, wing and panel flutter.

Prerequisite: ENAE324.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE425 Mechanics of Composite Structures (3 Credits)

Introduction to structures composed of composite materials and their applications in aerospace. In particular, filamentary composite materials are studied. Material types and fabrication techniques, material properties, micromechanics, anisotropic elasticity, introduction to failure concepts.

Prerequisite: MATH246, ENAE324, ENES220, and MATH241.

ENAE432 Control of Aerospace Systems (3 Credits)

An introduction to the feedback control of dynamic systems. Laplace transforms and transfer function techniques; frequency response and Bode diagrams. Stability analysis via root locus and Nyquist techniques. Performance specifications in time and frequency domains, and design of compensation strategies to meet performance goals.

Prerequisite: Minimum grade of C- in ENAE301 and ENAE283.

Restriction: Junior standing or higher; and must be in Engineering: Aerospace program.

ENAE441 Space Navigation and Guidance (3 Credits)

Principles of navigation. Celestial, radio, and inertial navigation schemes. Navigational and guidance requirements for orbital, planetary, and atmospheric entry missions. Fundamentals of communications and information theory. Link budgets, antennas and telemetry systems.

Prerequisite: ENAE404 and ENAE432.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE450 Robotics Programming (3 Credits)

Introduces students to the Robot Operating System (ROS) as well as to many of the available tools commonly used in robotics. Lectures focus on theory and structure, whereas laboratory sections will focus on applications and implementations. Students learn how to create software and simulations, interface to sensors and actuators, and integrate control algorithms. The course works through exercises involving a number of autonomous robots (i.e., ground and air vehicles) that students will eventually use in their subsequent RAS minor courses. Topics include: ROS architecture, console commands, ROS packages, simulation environments, visualizations, autonomous navigation, manipulation, and robot vision.

Prerequisite: ENME480 or ENAE380.

Restriction: Must be in the Robotics and Autonomous Systems (RAS) minor; or permission of department.

Additional Information: Students in the Robotics and Autonomous Systems minor should take ENME480 as a prerequisite; Aerospace Engineering students not in the minor should take ENAE380.

ENAE455 Aircraft Propulsion and Power (3 Credits)

Thermodynamic cycle analysis, aerothermochemistry of fuels and propellants, operating principles of piston, turbojet, fanjet, and other variations of airbreathing aircraft power units.

Prerequisite: ENES232, ENAE414, and ENAE311.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE457 Space Propulsion and Power (3 Credits)

Thermodynamic cycle analysis, aerothermochemistry of fuels and propellants, operating principles of rocket, ion, and other exoatmospheric power units.

Prerequisite: PHYS271, ENES232, PHYS270, and ENAE311.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department. And senior standing.

ENAE464 Aerospace Engineering Laboratory (3 Credits)

Application of fundamental measuring techniques to measurements in aerospace engineering. Includes experiments in aerodynamics, structures, propulsion, flight dynamics and astrodynamics. Correlation of theory with experimental results.

Prerequisite: ENAE324, ENAE362, ENAE311, and ENAE432.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE467 Advanced Space Propulsion and Power (3 Credits)

Charged particle motion, drift mechanisms, plasma sheaths, creation of plasmas. Representative electrothermal, electrostatic, and electromagnetic propulsion technologies. Power production and direct-drive thrust generation using fusion as time permits.

Prerequisite: ENAE457.

Restriction: Permission of Instructor. Jointly offered with: ENAE667.

Credit Only Granted for: ENAE488I, ENAE467, or ENAE667.

Formerly: ENAE488I.

ENAE471 Aircraft Flight Testing (3 Credits)

Provides basic instruction to aircraft flight testing and demonstrates need for systematic, well-proven technique to allow for accurate airplane performance. Concepts of aerodynamics, airplane performance, and stability and control. Emphasis on single-engine general aviation type aircraft.

Prerequisite: ENAE414.

Corequisite: ENAE403.

Restriction: Must be in Engineering: Aerospace program.

ENAE481 Principles of Aircraft Design (3 Credits)

Aircraft design principles blending both synthesis and analysis. The iterative nature of the design process. Applied aerodynamics. Elements of aircraft performance calculation and optimization. Design of aircraft including payload, crew and avionics provisions, propulsion selection and sizing, aerodynamic configuration optimization, mass properties, stability and control characteristics, and vehicle subsystems. Individual student projects in aircraft design.

Prerequisite: ENAE324, ENAE362, and ENAE432.

Corequisite: ENAE414.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE482 Aeronautical Systems Design (3 Credits)

Senior capstone design course in the aeronautics track. Introduction of computerized methods for sizing and performance analysis. More comprehensive methods to predict weight, aerodynamics and propulsion system characteristics. Consideration in design disciplines such as vulnerability, maintainability, produceability, etc. Groups of students will complete, brief and report on a major design study to specific requirements.

Prerequisite: ENAE455, ENAE423, ENAE403, and ENAE481.

Restriction: Must be in Engineering: Aerospace program; and senior standing or higher.

ENAE483 Principles of Space Systems Design (3 Credits)

Principles of space systems analysis and vehicle design. Launch vehicle performance analysis and optimization. Design of vehicle systems including avionics, power, propulsion, life support, human factors, structures, actuator and mechanisms, and thermal control. Design processes and design synthesis. Individual student projects in vehicle design.

Prerequisite: ENAE404, ENAE324, ENAE362, and ENAE432.

Restriction: Must be in Engineering: Aerospace program; or permission of ENGR-Aerospace Engineering department.

ENAE484 Space Systems Design (3 Credits)

Senior capstone design course in the space track. Group preliminary design of a space system, including system and subsystem design, configuration control, costing, risk analysis, and programmatic development. Course also emphasizes written and oral engineering communications.

Prerequisite: ENAE423, ENAE483, ENAE441, and ENAE457.

Restriction: Must be in Engineering: Aerospace program.

ENAE488 Topics in Aerospace Engineering (1-4 Credits)

Technical elective taken with the permission of the student's advisor and instructor. Lecture and conference courses designed to extend the student's understanding of aerospace engineering. Current topics are emphasized.

Prerequisite: Permission of student's advisor required.

Restriction: Permission of instructor.

ENAE499 Elective Research (3 Credits)

Undergraduate research project and paper conducted under the direction of an aerospace engineering faculty member to be presented at a conference or competition.

Prerequisite: Permission from student's advisor required.

Restriction: Senior standing or higher; and must be in Engineering: Aerospace program; and permission of instructor; and permission of ENGR-Aerospace Engineering department.

Repeatable to: 6 credits if content differs.