THE ACADEMY EDUCATES, TRAINS AND INSPIRES MEN AND WOMEN TO BECOME OFFICERS OF CHARACTER.

ASTRONAUTICAL ENGINEERING MAJOR

Suggested Course Sequence:

3rd-Class Year	2nd-Class Year	1st-Class Year
Astro Engr 201	Astro Engr 321	Acad Opt Depth Opt
Astro Engr 310	Astro Engr 331	Aero Engr 315
Chem 200	Astro Engr 351	Astro Engr 445
ECE 231	Beh Sci 310	Astro S E Design Opt
English 211	Econ 201	Astro S E Design Opt
Engr Mech 220	Engr 341	Biology 315
Engr Mech 320	Engr 342	ECE 348
Law 220	Engr Mech 330	English 411
Math 243	History 300	MSS 415
Math 245	Math 346	Philos 310
MSS 200	Math 356 /377	Soc Sci 412
Physics 215	Pol Sci 211	Space Environment Opt
Sys Opt Aero Engr 241		

ASTRONAUTICS (Astro Engr)

Offered by the Department of Astronautics (DFAS).

Astro Engr 201. Technology Skills for Astronautics. Self-paced course designed to provide the programming, modeling and simulation skills required in the various courses in the astronautical engineering major. Students are introduced to the MatLab™/Simulink™ tools for programming, modeling and simulation and to state-of-the-art 3-D computer tools for satellite analysis and visualization. A series of proficiency tasks must be completed using various tools over the course of the semester.

Astro Engr 310. Introduction to Astronautics. Introduction to the history, principles and challenges of space. Examines elements of space missions including orbits, spacecraft systems, launch vehicles, re-entry, operations and mission management. Emphasis on understanding the underlying physical principles and the system engineering process used to select orbits, plan maneuvers, and accomplish preliminary design of spacecraft payloads/subsystems to meet mission requirements. Reinforces concepts through hands-on use of application-based analysis and visualization software and communication of learned principles through written reports.

Astro Engr 310V. Introduction to Astronautics. The Department of Astronautics offers limited enrollment in AstroEngr 310V, an accelerated, instructor-assisted, self-study version of its core course, Astro Engr 310 - Introduction to Astronautics. This course is intended to help high-achieving cadets prepare for a final exam after 10 lessons. The final exam will be normal length and arranged via SCA at a time TBD on or near lesson 11. If the cadet scores over 70% on the final exam and over 50% on all major subject portions of the final exam, he/she will receive validation credit for AstroEngr 310. Cadets who don't meet the validation requirement will be moved into a traditional (semester-long) section of Astro Engr 310. Advisors with cadets who may be interested in taking this accelerated course should submit an APS for review and approval by DFAS by lesson 20 of the preceding semester.

Astro Engr 321. Intermediate Astrodynamics. Intermediate course in orbit mechanics. Topics include orbit determination and prediction, orbit maneuvers, perturbations, rendezvous and proximity operations. Emphasizes the design and use of structured computer programs to solve real-world astrodynamics problems. Programming experience is recommended.

Astro Engr 331. Space Systems Engineering. Presents fundamentals of space vehicle design with an emphasis on systems engineering. Introduces system-level spacecraft design issues including reliability, environments, radiation effects, testing, materials engineering, integration, launch vehicles and operations. Introduces and analyzes payloads, structures, propulsion, electrical power, communications and data handling, attitude determination and control, and thermal control subsystems. Includes an integrated lab experience where small teams analyze and integrate subsystems into a functioning small satellite called "EyeasSat." Teams demonstrate and document their EyeasSat at the system level as a part of the final evaluation.

Astro Engr 335. Human Spaceflight. The course focuses on design implications and costs/benefits of launching humans into space. It is an orientation for those students who are interested in participating in the Nation's human spaceflight program. The course also covers much of the history of human spaceflight, both its great successes and deep tragedies, from the Cold War to the International Space Station. The final project is an architectural design of the most demanding human spaceflight objective, a mission to Mars.

Astro Engr 351. Rocket Propulsion. Introduces rocket propulsion and propulsion system design. Uses the basic laws of thermodynamics, thermochemistry and conservation to determine ideal motor performance. Emphasis on describing thecomponents and conceptual design criteria for liquid, solid and hybrid rockets. Also studies electric, nuclear and otheradvanced propulsions systems.

Astro Engr 422. Advanced Astrodynamics. Continuation of Astro Engr 321, focuses on applying numerical and analytical techniques to solve realistic Air Force problems in astrodynamics and space operations. Examines perturbations and the associated effects on satellite orbits. Applies Least Squares and Kalman filter estimation techniques to the orbital prediction problem using batch and sequential processing. Uses structured computer programming extensively in problem solutions.

Astro Engr 423. Space Mission Design. Examines basic mission design principles for Air Force and civilian launch systems. Studies mission objectives and constraints; feasibility studies; time-line generation; launch, on-orbit and recovery operations; and contingency planning. Applies structured computer programming to analyze typical space missions.

Astro Engr 436. Small Spacecraft Engineering I. Introduction to small spacecraft systems engineering. Multi-disciplinary system design of spacecraft hardware and software to include subsystems, propulsion systems, attitude determination and control systems, electrical power systems, structures, payloads and ground stations. Define mission and system requirements, perform engineering trade studies, design and analyze spacecraft systems, and build and test flight hardware. Also includes opportunities to operate on-orbit small satellites.

Astro Engr 437. Small Spacecraft Engineering II. A second course in small spacecraft systems engineering. Multi-disciplinary system design and fabrication of spacecraft hardware and software to include subsystems, propulsion systems, attitude determination and control systems, electrical power systems, structures, payloads and ground stations. Finalize design, fabricate, test and fly actual spacecraft as a rideshare on a space launch vehicle. Also includes opportunities to operate on-orbit small satellites.

Astro Engr 445. Spacecraft Attitude Dynamics and Control. Fundamental introduction to the problem of controlling satellite attitude. Topics include direction cosine and Euler angle attitude parameters, torque-free rigid body motion, spin stabilization, gravity-gradient stabilization, momentum and reaction wheel control, and reaction

jet control. Projects include the development of a satellite attitude dynamics simulation and the design of a reaction wheel and reaction jet attitude control system.

Astro Engr 495. Special Topics. Selected topics in astronautics.

Astro Engr 499. Independent Study. Individual study and research supervised by a faculty member. Topic established withthe department head.

Astro Engr 543. Methods of Optimization for Engineers. Teaches optimization methods at graduate level. Topics include parameter optimization, optimization for dynamic systems, optimal control and numerical solutions.