AOE 4604 - Booster Design, Fabrication, and Operation (3 credits)
Theory, design, operations, and fabrication methodologies employed to manufacture boosters. The rocket equation, solid, liquid, and hybrid propellant systems, combustion chamber design, vehicle structures, telemetry, guidance and navigation, launch operations, and failure modalities.
Prerequisite(s): AOE 2074 and AOE 3124 and AOE 3154 and AOE 3164
Instructional Contact Hours: (3 Lec, 3 Crd)

AOE 4614 - Aerospace Materials and Modeling Techniques (3 credits)
Aircraft, spacecraft structural and engine materials. Mechanical, thermal properties and chemical stability of metallic materials. Aluminum, iron, nickel and titanium -based alloys. Atomistic structure, elastic properties, elastic anisotropy and microscopic origins. Plasticity, dislocations, and strengthening mechanism. Liquid-solid and solid-state phase transformation in alloys. Facture, creep and fatigue. Oxidation and corrosion. Simulating materials behaviors using molecular dynamics techniques.
Prerequisite(s): CHEM 1035 and PHYS 2305
Instructional Contact Hours: (3 Lec, 3 Crd)

AOE 4624 - Foundations of Aero and Hydroacoustics (3 credits)
Fundamental background to the field of aero/hydroacoustics. Quantifying sound levels, acoustic intensity, the acoustic wave equation, and linear acoustics. Fluid dynamics, turbulence, and thermodynamics in aeroacoustics. Lighthill's equation, and Curle's equation. Characterization and identification of aeroacoustic sources. Leading and trailing edge noise. Basics of aeroacoustic wind tunnel testing.
Prerequisite(s): AOE 3014 and AOE 3054
Instructional Contact Hours: (3 Lec, 3 Crd)

AOE 4634 - Wind Turbine Technology and Aerodynamics (3 credits)
Aerodynamics and elastic behavior of a modern wind turbine. Internal and aerodynamic loads of wind turbines. Locating wind turbines with respect to fatigue, annual power and noise productions. Aeroelastic behavior of wind turbine blades. Generators, transformers and power converters used in wind energy. Historical, economic, political, and innovation issues related to wind energy and power grid integration.
Prerequisite(s): AOE 3014 and (AOE 3124 or AOE 3224)
Instructional Contact Hours: (3 Lec, 3 Crd)

AOE 4654 - Space Weather: The Solar Wind and Magnetosphere (3 credits)
Solar-terrestrial interactions and space weather: the sun, solar wind, and interplanetary magnetic field; space plasma physics and magnetohydrodynamics; Earths magnetosphere and ionosphere; geomagnetic storms and auroral substorms; societal impacts of space weather; planetary magnetospheres; space science instrumentation.
Prerequisite(s): ECE 3105 or AOE 3014
Instructional Contact Hours: (3 Lec, 3 Crd)
Course Crosslist: ECE 4154

AOE 4674 - Upper Atmosphere/Ionosphere Space Weather (3 credits)
Interaction of Earth's upper atmosphere and space environment with spacecraft: processes that affect atmospheric density relevant to spacecraft orbit decay; basic composition and structure; radiation and radiative transfer; atmospheric energy balance; atmospheric chemistry and ion production/loss mechanisms; fundamental concepts of Solar-terrestrial physics including ionospheric Chapman theory; atmospheric energy/mass transport; ionospheric electrodynamics; ionospheric storms; planetary atmospheres/ionospheres; instrumentation.
Prerequisite(s): AOE 3014 or ECE 3105
Instructional Contact Hours: (3 Lec, 3 Crd)
Course Crosslist: ECE 4174

AOE 4804 - Special Topics in Dynamics, Control, and Estimation (3 credits)
Advanced undergraduate topics in dynamics, control, and estimation related to a particular class of aerospace and ocean engineering systems. Sample course topics include navigation and guidance, aircraft flight control, and ocean vessel motion control. May be repeated 2 times with different content for a maximum of 9 credits.
Prerequisite(s): AOE 4004
Instructional Contact Hours: (3 Lec, 3 Crd)
Repeatability: up to 9 credit hours

AOE 4814 - Special Topics in Propulsion (3 credits)
Advanced undergraduate topics in propulsion for aerospace and ocean vehicles. Covers technical, environmental, and economic challenges and opportunities in contemporary and future propulsion concepts. Comparative analyses of conventional and advanced propulsion systems and propulsion/vehicle integration concepts based upon first principles. Topics include distributed propulsion, green propulsion and propulsion/airframe integration. May be repeated with different content for a maximum of 6 credits.
Prerequisite(s): AOE 3164 or AOE 3264
Instructional Contact Hours: (3 Lec, 3 Crd)
Repeatability: up to 6 credit hours

AOE 4824 - Special Topics in Energy and the Environment (3 credits)
Advanced undergraduate topics in energy and the environment related to aerospace and ocean engineering systems. Sample course topics include renewable energy and energy management.
Prerequisite(s): AOE 3014
Instructional Contact Hours: (3 Lec, 3 Crd)

AOE 4864 - Special Topics in Space Engineering (3 credits)
Advanced undergraduate topics in space engineering. Covers technical, environmental, and economic challenges and opportunities in contemporary and future space systems and space missions. Comparative analyses of current and future space systems and missions, and space platform and payload concepts. Topics may include remote sensing, disaggregation, infrastructure, and mission modeling and simulation. May be repeated with different content for a maximum of 6 credits.
Prerequisite(s): AOE 3154
Instructional Contact Hours: (3 Lec, 3 Crd)
Repeatability: up to 6 credit hours

AOE 4974 - Independent Study (1-19 credits)
Instructional Contact Hours: Variable credit course

AOE 4984 - Special Study (1-19 credits)
Instructional Contact Hours: Variable credit course

AOE 4994 - Undergraduate Research (1-19 credits)
Instructional Contact Hours: Variable credit course

AOE 4994H - Undergraduate Research (1-19 credits)
Instructional Contact Hours: Variable credit course

Aerospace Engineering Major

Program Curriculum

Program Curriculum

Code	Title	Credits
Degree Core Requirements		
AOE 2024	Thin-Walled Structures	3
AOE 2054	Electronics for Aerospace and Ocean Engineers	3

AOE/ESM 2074	Computational Methods	2
AOE 3014	Fluid Dynamics for Aerospace and Ocean Engineers	3
AOE 3034	System Dynamics and Control	3
ESM 2114	Statics & Structures	3
ESM 2304	Dynamics	3
MATH 2114	Introduction to Linear Algebra	3
MATH 2204	Introduction to Multivariable Calculus	3
MATH 4564	Operational Methods for Engineers	3
PHYS 2306	Foundations of Physics	4
Subtotal		33
Major Requirements		
AOE 2104	Introduction to Aerospace Engineering and Aircraft Performance	3
AOE 3114	Aerodynamics & Compressibility	3
AOE 3124	Aerospace Structures	3
AOE 3134	Air Vehicle Dynamics	3
or AOE 3144	Space Vehicle Dynamics	
AOE 3154	Astromechanics	3
AOE 3164	Aerothermodynamics and Propulsion Systems	3
AOE 4105	Experiments for Aerospace Design	1
AOE 4106	Experiments for Aerospace Design	1
Subtotal		20
Major Electives		
Programming Elective		*3*
Select one of the following:		
CS 1044	Introduction to Programming in C	
CS 1064	Introduction to Programming in Python	
CS 1114	Introduction to Software Design	
Math Elective		*3*
Select one of the following:		
AOE/MATH 4404	Applied Numerical Methods	
or AOE 5404	Numerical Methods for Aerospace and Ocean Engineering	
MATH 4574	Vector and Complex Analysis for Engineers	
STAT 4705	Probability and Statistics for Engineers	
Vehicle Design Choice		*6*
Select one of the following sequences:		
AOE 4065 & AOE 4066	Air Vehicle Design and Air Vehicle Design	
AOE 4165 & AOE 4166	Space Vehicle Design and Space Vehicle Design	
Technical Electives		
Select nine credit hours of Track Technical Electives		9
Select six credit hours of Technical Electives		6
Pathways to General Education		
Pathways Concept 1 - Discourse		
ENGL 1105	First-Year Writing (1F)	3
ENGL 1106	First-Year Writing (1F)	3
AOE 3054	Experimental Methods (1A)	3
Select one of the following:		
AOE 4105 & AOE 4065	Experiments for Aerospace Design and Air Vehicle Design (1A)	
AOE 4105 & AOE 4165	Experiments for Aerospace Design and Space Vehicle Design (1A)	
Select one of the following:		
AOE 4106 & AOE 4066	Experiments for Aerospace Design and Air Vehicle Design (1A)	
AOE 4106 & AOE 4166	Experiments for Aerospace Design and Space Vehicle Design (1A)	
Pathways Concept 2 - Critical Thinking in the Humanities		
Select six hours in Pathway 2 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G02)		6
Pathways Concept 3 - Reasoning in the Social Sciences		
Select three hours in Pathway 3 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G03)		3
ECON 2005	Principles of Economics	3
or ECON 2006	Principles of Economics	
or ECON 2025H	Honors Principles of Economics	
Pathways Concept 4 - Reasoning in the Natural Sciences		
CHEM 1035 & CHEM 1045	General Chemistry and General Chemistry Laboratory	4
PHYS 2305	Foundations of Physics	4
Pathways Concept 5 - Quantitative and Computational Thinking		
MATH 1225	Calculus of a Single Variable (5F ; C-)	4
MATH 1226	Calculus of a Single Variable (5F)	4
MATH 2214	Introduction to Differential Equations (5A)	3
Pathways Concept 6 - Critique and Practice in Design and the Arts		
Select three hours in Pathway 6a (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G06A)		3
ENGE 1215 & ENGE 1216	Foundations of Engineering and Foundations of Engineering (6D)	4
or ENGE 1414	Foundations of Engineering Practice	
Pathways Concept 7 - Critical Analysis of Identity and Equity in the United States		
Pathways 7 should be double counted with either Pathways 2, 3, or 6a to avoid taking any additional credit hours. [1]		
Total Credits		**127**

[1] If a Pathways course is taken that does not double-count Pathways 7 with Pathways 2, 3 or 6a, then three more Pathways credits are needed (130 credits total).

Technical Electives

The AOE department requires 15 credits of technical electives, all of which must be taken on an A-F basis. ***Students are required to take a minimum of 9 credits from one of the approved Tracks.*** The remaining credits must be AOE courses not otherwise required for the AE major or from the list of approved technical electives below. Up to 6 of the 15 credits may be non-AOE technical courses from the list of approved technical electives or from the tracks. Courses other than those below may be acceptable as technical electives; however, substitutions must be approved by the AOE department ***before the course is taken***. Students are responsible for the satisfaction of prerequisites required for their chosen technical electives.

Code	Title	Credits
CEE 4384	Coastal Engineering	3
CEE 4674	Airport Planning and Design	3
CEE 5614	Analysis of Air Transportation Systems	3
CHEM 4615	Physical Chemistry for the Life Sciences	3
CS 1044	Introduction to Programming in C	3
CS 1054	Introduction to Programming in Java	3
If not taking as a programming elective		
CS 1064	Introduction to Programming in Python	3
If not taking as a programming elective		
CS 1114	Introduction to Software Design	3
If not taking as a programming elective		
CS 2064	Intermediate Programming in Python	3
CS 2114	Software Design and Data Structures	3
ECE 3104	Introduction to Space Systems and Technologies	3
ECE 3154	Space Systems - Design and Validation	2
ECE 3714	Introduction to Control Systems	3
ECE 4164	Introduction to Global Positioning System (GPS) Theory and Design	4
ECE 4194	Engineering Principles of Remote Sensing	3
ECE 4364	Alternate Energy for Climate Sustainability	3
ECE 4624	Digital Signal Processing And Filter Design	3
ECE 4634	Digital Communications	3
ECE 4644	Satellite Communications	3
ENGR 3124	Introduction to Green Engineering	3
ESM/MSE 3054	Mechanical Behavior of Materials	3
ESM 4024	Advanced Mechanical Behavior of Materials	3
ESM 4044	Mechanics of Composite Materials	3
ESM 4114	Nonlinear Dynamics and Chaos	3
ESM 4154	Nondestructive Evaluation of Materials	3
ESM/ME 4194	Sustainable Energy Solutions for a Global Society	3
ESM 4614	Probability-Based Modeling, Analysis, and Assessment	3
GEOG/GEOS 4354	Introduction to Remote Sensing	3
GEOS 3024	Computational Methods in the Geosciences	3
GEOS 3034	Oceanography (for AE majors only)	3
GEOS/GEOG 4354	Introduction to Remote Sensing	3
ISE 4404	Statistical Quality Control	3
MSE 2034	Elements of Materials Engineering	3
MSE/ESM 3054	Mechanical Behavior of Materials	3
MSE 4055	Materials Selection and Design I and II	3
MATH 3214	Calculus of Several Variables	3
MATH 4144	Linear Algebra II	3
MATH 4225	Elementary Real Analysis	3
MATH 4226	Elementary Real Analysis	3
MATH 4234	Elementary Complex Analysis	3
MATH 4245	Intermediate Differential Equations	3
MATH 4425	Fourier Series and Partial Differential Equations	3
MATH 4426	Fourier Series and Partial Differential Equations	3
MATH 4445	Introduction to Numerical Analysis	3
MATH 4446	Introduction to Numerical Analysis	3
MATH 4574	Vector and Complex Analysis for Engineers (if not used as math elective)	3
ME 2134	Thermodynamics	4
ME/ESM 4194	Sustainable Energy Solutions for a Global Society	3
ME 4204	Internal Combustion Engines	3
ME 4224	Gas Turbines for Power and Propulsion	3
ME 4524	Introduction to Robotics and Automation	3
ME 4534	Land Vehicle Dynamics	3
ME 4624	Finite Element Practice in Mechanical Design	3
ME 4634	Introduction to Computer-aided Design and Manufacturing	3
ME 4644	Introduction to Rapid Prototyping	3
ME 4724	Engineering Acoustics	3
MGT 3304	Management Theory and Leadership Practice	3
NSEG 3145	Fundamentals of Nuclear Engr	3
NSEG 3146	Fundamental of Nuclear Engr	3
PHIL/MGT 4324	Business and Professional Ethics	3
PHYS 3324	Modern Physics	4
PHYS 3405	Intermediate Electricity and Magnetism	3
PHYS 3406	Intermediate Electricity and Magnetism	3
PHYS 3655	Introduction to Astrophysics	3
PHYS 3656	Introduction to Astrophysics	3
PHYS 4455	Introduction to Quantum Mechanics	3
PHYS 4456	Introduction to Quantum Mechanics	3
PHYS 4504	Introduction to Nuclear and Particle Physics	3
PHYS 4554	Introduction to Solid State Physics	3
PHYS 4614	Optics	3
STAT 4105	Theoretical Statistics	3
STAT 4106	Theoretical Statistics	3
STAT 4705	Probability and Statistics for Engineers (for AE majors only, if not used as the math elective)	3
STAT 4706	Probability and Statistics for Engineers	3

Track Technical Electives

The AOE department requires 15 credits of technical electives. Students are required to take a minimum of 9 credits from one of the approved Tracks. Up to 6 of the 15 credits may be non-AOE technical courses selected either from Tracks or from the list of approved non-AOE technical courses. If a track includes a foundational course, the foundational course is required in that track, but it does not necessarily need to be taken first unless it is a prerequisite. Students must meet all pre-requisites and enrollment requirements for their select courses. Per the Graduate School policy, courses at the 5000 level are only available to seniors with a 3.0 or above overall GPA and the instructor's permission.

Foundational Track

The courses in the Foundational Track span the core areas in both Aerospace and Ocean Engineering. Achieving greater depth in analysis and understanding of these materials is very useful in building a strong general background in Aerospace and Ocean Engineering, and the Foundational Track allows students to acquire greater depth across the range of core areas in both aerospace and ocean engineering. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Required		
Select a minimum of 9 credit hours of the following:		9
AOE 3044	Boundary Layer and Heat Transfer	
or AOE 5144	Boundary Layer Theory and Heat Transfer	
AOE 4004	State-Space Control	
AOE/ESM 4084	Engineering Design Optimization	
AOE 4324	Energy Methods for Structures	
Total Credits		**9**

Aero/Hydrodynamics Track

Aero/Hydrodynamics is a core topic area in both Aerospace and Ocean Engineering. Analysis and understanding of Fluid Flows about vehicles is critical to the design of those vehicles. The Aero/Hydrodynamics Track will allow students with a particular interest in those topics to focus their technical electives in that area. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Required		
AOE 3044	Boundary Layer and Heat Transfer	3
or AOE 5144	Boundary Layer Theory and Heat Transfer	
Select a minimum of 6 credit hours of the following:		6
AOE 4064	Fluid Flows in Nature	
AOE 4114	Applied Computational Aerodynamics	
AOE 4124	Configuration Aerodynamics	
AOE 4434	Introduction to Computational Fluid Dynamics	
AOE 4474	Propellers and Turbines	
AOE 4624	Foundations of Aero and Hydroacoustics	
AOE 5104	Advanced Aero and Hydrodynamics	
AOE 5114	High Speed Aerodynamics	
AOE 5144	Boundary Layer Theory and Heat Transfer	
AOE 5154	Data Analysis in Fluid Dynamics	
Total Credits		**9**

Dynamics, Control and Estimation Track

Dynamics, Control and Estimation is a core topic area in both Aerospace and Ocean Engineering. The ability to model and predict the motion of a vehicle, and to modulate that motion through proper control design, is critical to the design of those vehicle systems. The Dynamics, Control and Estimation Track will allow students with a particular interest in those topics to focus their technical electives in that area. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Required		
AOE 4004	State-Space Control	3
Select a minimum of 6 credit hours of the following:		6
AOE 3134	Air Vehicle Dynamics (If not taking as required major course)	
AOE 3144	Space Vehicle Dynamics (If not taking as required major course)	
AOE 3234	Ocean Vehicle Dynamics (If not taking as required major course)	
AOE 4344	Dynamics of High-Speed Marine Craft	
AOE 4454	Spacecraft Position/Navigation/Timing and Orbit Determination	
AOE 4514	Nonlinear Dynamics and Chaos	
AOE 4804	Special Topics in Dynamics, Control, and Estimation	
ECE 3714	Introduction to Control Systems	
ECE 4624	Digital Signal Processing And Filter Design	
ESM 4114	Nonlinear Dynamics and Chaos	
ME 4534	Land Vehicle Dynamics	
AOE 5204	Vehicle Dynamics and Control	
AOE 5234	Orbital Mechanics	
AOE 5334	Advanced Ship Dynamics	
AOE 5734	Convex Optimization	
AOE 5744/ ME 5544/ ECE 5744	Linear Systems Theory	
AOE/ECE 5754/ME 5554	Applied Linear Systems	
AOE 5764/ ME 5564/ ECE 5764	Applied Linear Control	
AOE/ECE 5774/ME 5574	Nonlinear Systems Theory	
Total Credits		**9**

Energy and the Environment Track

Energy and the Environment, a major application area in both Aerospace and Ocean Engineering, focuses on imparting specific skills required to understand the nature, scope, and challenges of environmental impact and the science behind energy and propulsion systems that minimize that impact. The Energy and the Environment Track will allow students with a particular interest in environment impact, energy systems and renewable energy to focus their technical electives in that area. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Select a minimum of 9 credit hours of the following:		9
AOE 4064	Fluid Flows in Nature	
AOE 4474	Propellers and Turbines	
AOE 4624	Foundations of Aero and Hydroacoustics	
AOE 4634	Wind Turbine Technology and Aerodynamics	
AOE 4824	Special Topics in Energy and the Environment	
AOE 5154	Data Analysis in Fluid Dynamics [1]	
ECE 4364	Alternate Energy for Climate Sustainability	
ENGR 3124	Introduction to Green Engineering	
ESM/ME 4194	Sustainable Energy Solutions for a Global Society	
Total Credits		**9**

Naval Engineering Track

Naval Engineering is an application track in both Aerospace and Ocean Engineering. Understanding naval missions, capability requirements and the broad scope of engineering applications to naval missions, and developing particular technical application knowledge in elective courses, will provide students with a unique and valuable skill set. These skills will enable the student to perform research and work in this field. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Required		
AOE 4264	Principles of Naval Engineering	3
or AOE 5324	Principles of Naval Engineering with Applications	
Select a minimum of 6 credit hours of the following:		6
AOE 4244	Naval and Marine Engineering Systems Design	
or AOE 5314	Naval and Marine Engineering Systems Design	
AOE 4274	Intermediate Ship Structural Analysis	
AOE 4344	Dynamics of High-Speed Marine Craft	
AOE 4474	Propellers and Turbines	
AOE 5074	Advanced Ship Structural Analysis	
AOE 5314	Naval and Marine Engineering Systems Design	
AOE 5324	Principles of Naval Engineering with Applications	
AOE 5334	Advanced Ship Dynamics	
ECE 4164	Introduction to Global Positioning System (GPS) Theory and Design	
ECE 4364	Alternate Energy for Climate Sustainability	
Total Credits		**9**

Propulsion Track

The study of Propulsion, a core technology in Aerospace and Ocean Engineering, focuses on learning and applying fundamental knowledge to understand the nature, scope, opportunities and challenges of designing, specifying and integrating propulsion technologies. The Propulsion Track will allow students with a particular interest in the design, and analysis of aircraft, spacecraft or ocean propulsion to focus their technical electives in that area. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Select a minimum of 9 credit hours of the following:		9
AOE 3044	Boundary Layer and Heat Transfer	
AOE 4174	Spacecraft Propulsion	
AOE 4234	Aerospace Propulsion Systems	
AOE 4474	Propellers and Turbines	
AOE 4604	Booster Design, Fabrication, and Operation	
AOE 4624	Foundations of Aero and Hydroacoustics	
AOE 4814	Special Topics in Propulsion	
AOE 5144	Boundary Layer Theory and Heat Transfer	
AOE 5154	Data Analysis in Fluid Dynamics	
AOE 5184	High Speed Propulsion	
Total Credits		**9**

Space Engineering Track

Space Engineering is a core topic area in both Aerospace and Ocean Engineering. Analysis and understanding of the space environment, space payloads, and/or space mission design and operations is critical to the design, analysis, and functioning of those space vehicles and payloads. The Space Engineering Track will allow students with a particular interest in those topics to focus their technical electives in that area. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Select a minimum of 9 credit hours of the following:		9
AOE 2664	Exploration of the Space Environment	
AOE 4174	Spacecraft Propulsion	
AOE 4414	Computer Aided Space Mission Analysis	
AOE 4454	Spacecraft Position/Navigation/Timing and Orbit Determination	
AOE 4604	Booster Design, Fabrication, and Operation	
AOE 4654/ ECE 4154	Space Weather: The Solar Wind and Magnetosphere	
AOE 4674	Upper Atmosphere/Ionosphere Space Weather	
AOE 4864	Special Topics in Space Engineering	
AOE/ECE 5174	Introduction to Plasma Science	
AOE 5184	High Speed Propulsion	
AOE 5234	Orbital Mechanics	
ECE 3104	Introduction to Space Systems and Technologies	
ECE 3154	Space Systems - Design and Validation	
ECE 4164	Introduction to Global Positioning System (GPS) Theory and Design	
ECE 4194	Engineering Principles of Remote Sensing	
PHYS 3655	Introduction to Astrophysics	
PHYS 3656	Introduction to Astrophysics	
Total Credits		**9**

Structures and Materials Track

Structures and Materials is a core topic area in both Aerospace and Ocean Engineering. Analysis and understanding of structural analysis and materials selection for aerospace and ocean vehicles is critical to the design of those vehicles. The Structures and Materials Track will allow students with a particular interest in those topics to focus their technical electives in that area. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Required		
AOE 4324	Energy Methods for Structures	3
Select a minimum of 6 credit hours of the following:		6
AOE 4024/ ESM 4734	An Introduction to the Finite Element Method	
AOE 4034	Introduction to Mechanical and Structural Vibrations	
AOE 4054/ ESM 4444	Stability of Structures	
AOE 4274	Intermediate Ship Structural Analysis	
AOE 4614	Aerospace Materials and Modeling Techniques	
AOE 5024	Vehicle Structures	
AOE 5034/ ESM 5304	Mechanical and Structural Vibrations	
AOE 5074	Advanced Ship Structural Analysis	
ESM/MSE 3054	Mechanical Behavior of Materials	
ESM 4024	Advanced Mechanical Behavior of Materials	
ESM 4044/ CEE 4610	Mechanics of Composite Materials	
ME 4624	Finite Element Practice in Mechanical Design	
MSE 2034	Elements of Materials Engineering	
Total Credits		**9**

Vehicle and System Design Track

Vehicle and System Design is a core discipline in both Aerospace and Ocean Engineering. Its focus is on imparting specific skills required to understand the nature, scope, and challenges of designing innovative vehicles and systems by synthesizing foundational knowledge from other courses. The Vehicle and System Design Track will allow students with a particular interest in design and operation of aircraft, spacecraft, and ocean vehicles to focus their technical electives. This Track is available to all Aerospace and Ocean Engineering majors.

Code	Title	Credits
Required		
AOE/ESM 4084	Engineering Design Optimization	3
Select a minimum of 6 credit hours of the following:		6
AOE 3354	Avionics Systems	
AOE 3564	Principles of Project Design and Management	
AOE 3804	Special Topics in Aircraft Systems (HAW)	
AOE 4124	Configuration Aerodynamics	
AOE 4244	Naval and Marine Engineering Systems Design	
or AOE 5314	Naval and Marine Engineering Systems Design	
AOE 4264	Principles of Naval Engineering	
or AOE 5324	Principles of Naval Engineering with Applications	
AOE 4604	Booster Design, Fabrication, and Operation	
AOE 4814	Special Topics in Propulsion	
CEE 5614	Analysis of Air Transportation Systems	
Total Credits		**9**

Satisfactory Progress Towards Degree

University Policy 91 outlines university-wide minimum criteria to determine if students are making satisfactory progress towards the completion of their degrees. The AOE Department fully supports this policy. Specific expectations for satisfactory progress for AE majors are as follows:

- Each student must meet the minimum University-wide criteria as described in Policy 91 and summarized in the Undergraduate Catalog: https://www.undergradcatalog.registrar.vt.edu/
- A student must have at least 2.0 overall and in-major GPAs. (The in-major GPA consists of all courses taken under the AOE designation).

Graduation Requirements

Students must pass all required courses and both the in-major and overall GPA must be at least 2.0 for graduation. The in-major GPA consists of all courses taken under the AOE designation. No courses in this program may be taken on a Pass/Fail basis.

Economics Requirement

ECON 2005 Principles of Economics **is required for graduation** and may be taken as one of the two Concept 3 requirements in the Pathways. If a student chooses to satisfy the Concept 3 requirements with courses not including ECON 2005 Principles of Economics, ISE 2014 Engineering Economy may also be used to satisfy this requirement but this requires additional credits.

ESM 2114 Requirement

ESM 2114 Statics & Structures **is required for graduation.** ESM 2104 Statics and ESM 2204 Mechanics of Deformable Bodies may be substituted in place of ESM 2114 Statics & Structures. However, doing so requires that a student take 6 credits instead of the 3 required for ESM 2114 Statics & Structures.

Aerospace Engineering Primary and Ocean Engineering Secondary

AE primary majors with an OE secondary major may substitute (4065-4066 or 4165-4166) for 4265-4266 and 4105-4106 for 4205-4206 in their secondary OE major (substitutions are not permitted for dual degrees).

Course Offerings

Course offerings are subject to change and the availability of sufficient resources.

Acceptable Substitutions

1. MATH 2405H may be substituted for MATH 2114
2. MATH 2405H + MATH 2406H may be substituted for MATH 2114 + MATH 2204 + MATH 2214
3. ESM 2104 + ESM 2204 may be substituted for ESM 2114

Foreign Language Requirement

Students must have had 2 years of a foreign language in high school or one year at the college level (6 credit hours) of the same language. College-level credits used to meet this requirement do not count towards the degree.

Roadmap

First Year		
Fall Semester		**Credits**
CHEM 1035	General Chemistry	3
CHEM 1045	General Chemistry Laboratory	1
ENGL 1105	First-Year Writing	3
MATH 1225	Calculus of a Single Variable	4
ENGE 1215	Foundations of Engineering	2
Pathways 2 and/or 7 [1]		3
	Credits	**16**
Spring Semester		
ENGL 1106	First-Year Writing	3
MATH 1226	Calculus of a Single Variable	4
PHYS 2305	Foundations of Physics	4
ENGE 1216	Foundations of Engineering	2
Select one of the following programming electives.		3
CS 1044	Introduction to Programming in C	
CS 1064	Introduction to Programming in Python	
CS 1114	Introduction to Software Design	
	Credits	**16**
Second Year		
Fall Semester		
ESM 2114	Statics & Structures	3
MATH 2114	Introduction to Linear Algebra	3
MATH 2204	Introduction to Multivariable Calculus	3
AOE 2054	Electronics for Aerospace and Ocean Engineers	3
AOE 2074	Computational Methods	2

AOE 2104	Introduction to Aerospace Engineering and Aircraft Performance	3
	Credits	**17**
Spring Semester		
ESM 2304	Dynamics	3
MATH 2214	Introduction to Differential Equations	3
AOE 2024	Thin-Walled Structures	3
PHYS 2306	Foundations of Physics	4
ECON 2005	Principles of Economics (Pathways 3)	3
	Credits	**16**
Third Year		
Fall Semester		
MATH 4564	Operational Methods for Engineers	3
AOE 3014	Fluid Dynamics for Aerospace and Ocean Engineers	3
AOE 3034	System Dynamics and Control	3
AOE 3124	Aerospace Structures	3
AOE 3154	Astromechanics	3
	Credits	**15**
Spring Semester		
AOE 3114	Aerodynamics & Compressibility	3
AOE 3134 or AOE 3144	Air Vehicle Dynamics or Space Vehicle Dynamics	3
AOE 3164	Aerothermodynamics and Propulsion Systems	3
AOE 3054	Experimental Methods	3
Track Technical Elective		3
	Credits	**15**
Fourth Year		
Fall Semester		
AOE 4105	Experiments for Aerospace Design	1
Vehicle Design Choice		3
Select one of the following MATH Electives:		3
MATH 4574	Vector and Complex Analysis for Engineers	
MATH 4404	Applied Numerical Methods	
STAT 4705	Probability and Statistics for Engineers	
Track Technical Elective		3
Technical Elective		3
Pathways 6a and/or 7 [1]		3
	Credits	**16**
Spring Semester		
AOE 4106	Experiments for Aerospace Design	1
Vehicle Design Choice		3
Track Technical Elective		3
Technical Elective		3
Pathways 2 and/or 7 [1]		3
Pathways 3 and/or 7 [1]		3
	Credits	**16**
	Total Credits	**127**

[1] Total program credit hours of 127 required is based on a Pathway 7 course double counting with Pathway 2, 3, or 6a. If you elect to complete a Pathway 7 course that does not double count, an additional three Pathway credits will be needed for degree completion (130 credits total).

Ocean Engineering Major

Program Curriculum

Code	Title	Credits
Degree Core Requirements		
AOE 2024	Thin-Walled Structures	3
AOE 2054	Electronics for Aerospace and Ocean Engineers	3
AOE/ESM 2074	Computational Methods	2
AOE 3014	Fluid Dynamics for Aerospace and Ocean Engineers	3
AOE 3034	System Dynamics and Control	3
ESM 2114	Statics & Structures	3
ESM 2304	Dynamics	3
MATH 2114	Introduction to Linear Algebra	3
MATH 2204	Introduction to Multivariable Calculus	3
MATH 4564	Operational Methods for Engineers	3
PHYS 2306	Foundations of Physics	4
Subtotal		33
Major Requirements		
AOE 2204	Introduction to Ocean Engineering	3
AOE 3214	Ocean Wave Mechanics	3
AOE 3224	Ocean Structures	3
AOE 3234	Ocean Vehicle Dynamics	3
AOE 3264	Thermodynamics and Marine Propulsion	3
AOE 4205	Experiments for Ocean Vehicle Design	1
AOE 4206	Experiments for Ocean Vehicle Design	1
AOE 4265	Ocean Vehicle Design	3
AOE 4266	Ocean Vehicle Design	3
GEOS 3034	Oceanography	3
STAT 4705	Probability and Statistics for Engineers	3
Subtotal		29
Major Electives		
Programming Elective		
Select one of the following programming electives		3
CS 1044	Introduction to Programming in C	
CS 1064	Introduction to Programming in Python	
CS 1114	Introduction to Software Design	
Technical Electives		
Select nine credit hours of Track Technical electives.		9
Select six credit hours of Technical electives.		6
Pathways to General Education		
Pathways Concept 1 - Discourse		
ENGL 1105	First-Year Writing (1F)	3
ENGL 1106	First-Year Writing (1F)	3
AOE 3054	Experimental Methods (1A)	3
AOE 4205 & AOE 4265	Experiments for Ocean Vehicle Design and Ocean Vehicle Design (1A)	
AOE 4206 & AOE 4266	Experiments for Ocean Vehicle Design and Ocean Vehicle Design (1A)	
Pathways Concept 2 - Critical Thinking in the Humanities		
Select six hours in Pathway 2 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G02)		6
Pathways Concept 3 - Reasoning in the Social Sciences		
Select three hours in Pathway 3 (https://catalog.vt.edu/course-search/?attrs_pathways=attrs_pathways_G03)		3
ECON 2005	Principles of Economics	3
or ECON 2006	Principles of Economics	
or ECON 2025H	Honors Principles of Economics	
Pathways Concept 4 - Reasoning in the Natural Sciences		