



CLASS of 2021

TO: Students Entering Aerospace and Ocean Engineering  
FROM: Dr. Eric Paterson, Professor and Department Head  
SUBJECT: Transfer into Aerospace and Ocean Engineering

Welcome to AOE. We are pleased that you have chosen to join us and we look forward to working with you toward earning a degree majoring in Aerospace Engineering (AE) or Ocean Engineering (OE) or both. We think you will find this department an exciting place to be, and we hope you will take advantage of all the department has to offer over your next few years with us.

In the following material you will find up-to-date versions of our academic requirements. **It is very important that you keep this information.** The University Registrar maintains the official curricular listings for majors in AE and OE, called check sheets. **Your graduation requirements will be those in effect for the year in which you graduate, and not those that were in effect on date of entry.**

<http://www.registrar.vt.edu/graduation/checksheets/index.html>

In contrast, Curriculum for Liberal Education (CLE) requirements are based on *date of entry*. Courses satisfying the CLE requirements may change every year. Please refer to the CLE website, <http://www.cle.prov.vt.edu/guides/>, for up to date information. If you fall behind your previously planned graduation date, then you should see your advisor to make sure that delay does not cause you any problems in meeting graduation requirements.

In the following material you will find information about our two departmental student branches of international technical society organizations, the AIAA and SNAME/ASNE. We strongly encourage you to become an active part of at least one of these groups. I can think of no better way to meet other AOE students and faculty and to get involved in the department and invest in your future success.

We look forward to getting to know you and working with you. My office is always open to you should you have any questions about our department, our programs or any other concerns. I am in 215 Randolph Hall, and, should I be in class or otherwise unavailable when you come by, the receptionist will be glad to make an appointment for you.

## Aerospace & Ocean Engineering Departmental Information

**E**MAIL NOTIFICATIONS: Official notification of important events in AOE or changes to curricula, class scheduling, academic standing, etc. will be sent to you via email. The department maintains email distribution lists for each class. Your class standing for these lists depends on what courses you are taking, not the number of hours you have accumulated. We will use your PID (vt.edu address), so if you prefer to use a different address, use the PID tool to forward your mail to that address. *Read your email—it could be important!*

**A**DVISING and REGISTRATION: Mrs. Madhu Kapania and Mr. Brian Kastner are your academic advisors who may help with course registration, curricular planning or with any other matter. Every student in AOE is assigned an advisor for academic and career advice. Experience shows that students are often reluctant to see advisors, even at registration time. This is frustrating to advisors who want to help their advisees and becomes more frustrating when the student, without proper advice, takes the wrong courses or makes other mistakes that may needlessly delay graduation. The AOE department considers advising an important part of the course registration process. Students should meet with their advisors during the registration period for assistance with any registration and curricular planning problems. Students are encouraged use the Degree Audit Reporting System (DARS) and review the report with their advisor, especially before registering for senior year. Should you ever feel that you have problems communicating with your advisor or want to change advisors for any reason, see the Assistant Department Head of Academics Affairs, Dr. Canfield.

Many students take additional courses beyond the 128 credits required for graduation due to situations such as failure to satisfy a given CLE area or taking a course on a P/F or Audit basis that doesn't count toward graduation. **Always consult with your advisor before registering for future terms and before dropping any course.** Every year students drop courses without considering the need for the course as a prerequisite for later courses, some of which are only offered once each year. The result can be a full year delay in graduation due to dropping a single course!

**C**AREER ADVISING: The AOE Department encourages its students to make career planning part of their long term educational process. Co-op and summer employment are definite plusses on a student's résumé, along with student technical society activities and undergraduate research experience. The department also has an "Academic Career Advisor" to help students with any and all aspects of career planning. Mrs. Madhu Kapania is the Career Advisor for AE and OE students, and she will be glad to help our students with resume preparation, job recommendations, etc. She will also refer students to faculty as needed.

**C**O-OP: The AOE Department encourages students to participate in the University Co-op Program and will work with them to develop a practical academic schedule with alternate work and study terms to allow graduation in that program. Mrs. Madhu Kapania is the department's Co-op advisor. Co-op is an excellent way to gain valuable "real world" experience, earn extra money and line up a job upon graduation. Interested students should begin by contacting the Career Services Office.

**C**COURSE WITHDRAWAL POLICY: You may withdraw from a course without academic penalty up until the last day of class. You can only do this for three courses during your career at Virginia Tech. *This policy has the potential for serious misuse leading to major delays in*

**graduation.** Note that this policy must be used prior to the end of the course and may not be applied afterwards. It also requires the permission of the student's department and Dean.

**DOUBLE MAJORS and TWO DEGREES:** Many AOE students choose to earn a double major in the "other" curriculum in the department. A double major only receives a diploma with the primary major listed, even though both majors are indicated on the student's transcript. A double major certificate is issued to recognize the second major. The university requires that a graduate desiring two diplomas (called "two degrees") take a minimum of thirty extra credits, even though that many credits may not be needed for completion of the second degree program. It is generally advisable to pursue a Master's Degree rather than "two degrees" if one has the time to take 30 credits beyond the single BS degree.

Some AOE students may be interested in a second major outside the department. The department will work with students who desire a second major to plan their academic program. While this is rare and often involves significant additional coursework, AOE students have graduated with second majors in Math, Physics, English, Philosophy, Chemistry and other engineering programs. Again, it is generally in one's best interest to pursue a Master's Degree program rather than a second major.

**MINORS:** Minors often require significant additional coursework beyond the 128 credits necessary to graduate and are not generally available in engineering majors; however, a **math minor**, requires little additional study beyond the math credits which are already a part of the AE and OE curricula. Interested students should contact the Math Department for a list of minor requirements and for the forms needed to sign up for the minor.

**PASS/FAIL COURSES:** All required AOE courses and all math, science and technical electives must be taken on an A/F basis. The university requires that all CLE courses must also be taken for A/F credit. *Only "free" electives and courses offered only P/F may be taken P/F.*

**TECHNICAL AND MATH ELECTIVES:** Technical and math electives acceptable in the AOE programs of study are listed on pages that follow. Substitutions for these listed courses may be made *with the prior approval of the student's advisor in cases where a course meets a special career objective or where a new course is not on the list.*

**TIME NEEDED TO GRADUATE:** The curricula in AOE are designed to facilitate graduation in four years (five years for co-op students). **Most required junior and senior level AOE courses are only offered once per year**, making it difficult to "stretch" the program over a longer period. The department, however, realizes that some students enter the department later than normal or with fewer credits than normal and there are others who need to accommodate special programs such as ROTC or sports participation. Students enrolled in a **ROTC program** must meet the requirements of that program in addition to the AOE graduation requirements. Few ROTC courses will satisfy elective course requirements in the major. ROTC students will usually have to delay taking CLE and other elective courses to allow room for ROTC course requirements. Unfortunately, ROTC summer training requirements often prevent catching up on delayed courses during summer sessions. With very careful early planning it is possible for the ROTC student to graduate in four years, but most may need at least one extra semester for completion of academic and ROTC requirements. We will work with such students to develop the needed schedule of coursework within the restrictions imposed by course teaching schedules, curricular and accreditation requirements, and elective availability. *Students anticipating any deviation from the listed curriculum for any reason are urged to see their advisor before selecting an alternate schedule. Delaying any of the courses in the curriculum without proper planning and consideration of the consequences can easily cost the student an extra year before graduation because of course sequencing and availability.*

**THE SENIOR DESIGN COURSE:** The capstone design course sequence has three different course options: AOE 4065-66 Air Vehicle Design, 4165-66 Space Vehicle Design, and AOE 4265-66 Ocean Vehicle design. Aerospace Engineering majors choose between Aircraft and Spacecraft Design. Ocean Engineering majors must take Ship Design. Students will have to complete all the prerequisite courses in the junior year of the applicable curriculum to enroll in the design sequences. Note that AOE 4165 Space Vehicle Design has a prerequisite of AOE 3144 Space Vehicle Dynamics and Control, which has a prerequisite of AOE 3154 Astromechanics. Therefore, students wishing to take Space Vehicle Design must take AOE 3154 in the fall of the junior year and must take AOE 3144 instead of AOE 3134 in the spring of the junior year. Students wishing to take Air Vehicle Design can choose to postpone taking Astromechanics in the fall of senior year.

**TECHNICAL AND HONOR SOCIETIES:** The AOE Department is fortunate to have three outstanding student sections or branches of national organizations. We strongly recommend student participation in one or both of the two technical societies and an invitation to join the third group will follow good academic performance in the program.

**AIAA** The American Institute of Aeronautics and Astronautics is the leading international technical society for aerospace professionals. The Virginia Tech student branch is among the largest and most active in AIAA. Activities include regular meetings, a regional paper competition and design competitions. Drs. Patil is the AIAA Faculty Advisors.

**SNAME/ASNE** The Society of Naval Architects and Marine Engineers and American Society of Naval Engineers are the professional society for Ocean Engineers. The Tech student group has been very active and successful in SNAME national programs and design competitions. Members hold regular meetings and highlight their year with a trip to the SNAME national meeting. Dr. Brown is the Faculty Advisor.

**ΣΓΤ** Sigma Gamma Tau is the national Aerospace honor society. Each term ΣΓΤ selects the top AOE juniors and seniors for membership. Students in AOE are invited to join. Dr. Seidel is the faculty advisor.

COLLEGE OF ENGINEERING  
DEPARTMENT OF AEROSPACE AND OCEAN ENGINEERING  
**BACHELOR OF SCIENCE IN AEROSPACE AND OCEAN ENGINEERING, MAJOR: AEROSPACE ENGINEERING**  
FOR STUDENTS GRADUATING IN CALENDAR YEAR 2020  
128 CREDITS REQUIRED FOR GRADUATION

FRESHMAN FALL SEMESTER 2016		Credits	FRESHMAN SPRING SEMESTER 2017		Credits
CHEM 1035 General Chemistry	Co: MATH 1025 or 1225	3	ENGL 1106 First-Year Writing	Pre: ENGL 1105	3
CHEM 1045 General Chemistry Lab	Co: CHEM 1035	1	MATH 1226 Calculus of a Single Variable	Pre: MATH 1225 (C-)	4
ENGL 1105 First-Year Writing		3	PHYS 2305 Foundations of Physics	Pre: MATH 1205 or MATH 1205H or MATH 1225 or MATH 1206 or MATH 1206H or MATH 1226; Co: PHYS 2325 or MATH 1206 or MATH 1206H or MATH 1226	4
MATH 1225 Calculus of a Single Variable (C-)	Pre: Math Ready	4	ENGE 1216 Foundations of Engineering (C-)	Pre: ENGE 1215 (C-)	2
ENGE 1215 Foundations of Engineering (C-)		2	CLE (Area 2, 3, or 7)		3
CLE (Area 2, 3, or 7)		3			
	<b>TOTAL</b>	<b>16</b>		<b>TOTAL</b>	<b>16</b>
SOPHOMORE FALL SEMESTER 2017		Credits	SOPHOMORE SPRING SEMESTER 2018		Credits
ESM 2114 <sup>(1)</sup> Statics and Structures	Co: MATH 2204 or MATH 2204H or MATH 2406H	3	ESM 2304 <sup>(1)</sup> Dynamics	Pre: 2104 or 2114, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H) Co: MATH 2214	3
MATH 2114 <sup>(1)</sup> Introduction to Linear Algebra	Pre: MATH 1225 (min grade of B) or MATH 1226	3	MATH 2214 <sup>(1)</sup> Introduction to Differential Equations	Pre: 1114 or 1114H or 2114 or 2114H, (1206 or 1226)	3
MATH 2204 <sup>(1)</sup> Introduction to Multivariable Calculus	Pre: MATH 1226	3	AOE 2024 <sup>(1)</sup> Thin-Walled Structures	Pre: ESM 2114, MATH 2224(H) or MATH 2204(H); Co: MATH 2214	3 [F, S]
AOE 2054 <sup>(1)</sup> Electronics for Aerospace and Ocean Engineers		3 [F]	PHYS 2306 Foundations of Physics	Pre: MATH 1206 or MATH 1206H or MATH 1226, PHYS 2305	4
AOE 2074 <sup>(1)</sup> (ESM 2074) Computational Methods	Pre: ENGE 1114 or ENGE 1216 or ENGE 1434	2 [F, S, SI]	CLE (Area 3) ECON 2005 Principles of Economics		3
AOE 2104 <sup>(2)</sup> Introduction to Aerospace Engineering and Aircraft Performance	Pre: ENGE 1216, PHYS 2305, Co: ESM 2104 or ESM 2114	3 [F, SI]	CLE (Area 6)		1
	<b>TOTAL</b>	<b>17</b>		<b>TOTAL</b>	<b>17</b>
JUNIOR FALL SEMESTER 2018		Credits	JUNIOR SPRING SEMESTER 2019		Credits
MATH 4564 <sup>(1)</sup> Operational Methods for Engineers	Pre: (2214 or 2214H) or 2406H or CMDA 2006	3	AOE 3114 <sup>(2)</sup> Aerodynamics and Compressibility	Pre: 3014, Co: 3164	3 [S]
AOE 3014 <sup>(1)</sup> Fluid Dynamics for Aerospace and Ocean Engineers	Pre: (2104 or 2204), ESM 2304, MATH 2214	3 [F]	AOE 3134 <sup>(2)</sup> Air Vehicle Dynamics	Pre: 3034, or	3 [S]
AOE 3034 <sup>(1)</sup> System Dynamics and Control	Pre: ESM 2304, (MATH 2214 or MATH 2214H)	3 [F]	AOE 3144 <sup>(2)</sup> Space Vehicle Dynamics,	Pre: 3034	3 [S]
AOE 3124 <sup>(2)</sup> Aerospace Structures	Pre: 2024 or 3024	3 [F, S]	AOE 3164 <sup>(2)</sup> Aerothermodynamics and Propulsion Systems	Pre: 3014, Co: 3114	3 [S]
AOE 3154 <sup>(2)</sup> Astromechanics	Pre: ESM 2304	3 [F]	AOE 3054 <sup>(1)</sup> Experimental Methods	Pre: 2054, 3014, 3034	3 [S]
	<b>TOTAL</b>	<b>15</b>	Track Technical Elective		3
			<b>TOTAL</b>	<b>TOTAL</b>	<b>15</b>
SENIOR FALL SEMESTER 2019		Credits	SENIOR SPRING SEMESTER 2020		Credits
AOE 4105 <sup>(2)</sup> Experiments for Aerospace Design	Pre: 3054; Co: 4065 or 4165	1 [F]	AOE 4106 <sup>(2)</sup> Experiments for Aerospace Design	Pre: 4105, Co: 4066 or 4166	1 [S]
AOE 4065 <sup>(2)</sup> Air Vehicle Design, Pre: 2104, 3054, 3114, 3124, 3134, 3164; Co: 4105 or		3 [F]	AOE 4066 <sup>(2)</sup> Air Vehicle Design	Pre: 4065; Co: 4106 or	3 [S]
AOE 4165 <sup>(2)</sup> Space Vehicle Design, Pre: 2104, 3054, 3114, 3124, 3144, 3154, 3164; Co: 4105			AOE 4166 <sup>(2)</sup> Space Vehicle Design	Pre: 4165; Co: 4106	
MATH Elective	Choice of: MATH 4574 <sup>(2)</sup> , MATH 4404 <sup>(2)</sup> , or STAT 4705 <sup>(2)</sup>	3	Track Technical Elective		3
Track Technical Elective		3	Technical Elective		3
Technical Elective		3	Technical Elective		3
CLE (Area 2, 3, or 7)		3	CLE (Area 2, 3, or 7)		3
	<b>TOTAL</b>	<b>16</b>		<b>TOTAL</b>	<b>16</b>

**General Information about Checksheet:** Superscripted annotation [F,S,SI,SII] in Credits column indicates terms when a course is expected to be offered. Course offerings are subject to change and the availability of sufficient resources. Students should confirm course offerings in advance with their department. Curriculum for Liberal Education (CLE) courses are shaded in Green. AOE common degree core courses common to AE and OE majors are shaded in Blue and contain a superscripted annotation (1) after the course number. AOE courses specific to AE Major are shaded in Yellow and contain a superscripted annotation (2) after the course number. 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.

**Curriculum for Liberal Education (CLE)**

Consult the CLE Alphabetical Listing at: <http://www.cle.prov.vt.edu/guides/alpha.html>, CLE courses need to be completed prior to graduation

CLE Area 1: Writing and Discourse (6 hrs)	ENGL 1105	(3)	ENGL 1106	(3)
CLE Area 2: Ideas, Cultural Traditions, Values Electives (6 hrs)		(3)		(3)
CLE Area 3: Society & Human Behavior electives (6 hrs)	ECON 2005	(3)		(3)
CLE Area 4: Scientific Reasoning and Discovery (8 hrs)	PHYS 2305	(4)	PHYS 2306	(4)
CLE Area 5: Quantitative and Symbolic Reasoning (8 hrs)	MATH 1225	(4)	MATH 1226	(4)
CLE Area 6: Creativity & Aesthetic Experience elective (1 hr)				(1)
CLE Area 7: Global Issues Elective (3 hrs)				(3)

If a CLE course is double-counted to satisfy two different CLE areas, then a free elective(s) must be taken to maintain a minimum of 128 credits.

**Technical Electives:** The AOE department requires 18 credits of technical electives. *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 AE major. Up to 3 of the 18 credits may be non-AOE technical courses selected either from Tracks or from the attached list of approved non-AOE technical courses.

**Change of Major Requirements:** Please see <http://www.enge.vt.edu/undergraduate-changing-majors.html>

**Foreign Language Requirements:** 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.

**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 (<http://www.undergradcatalog.registrar.vt.edu/1617/academic-policies.html#22><http://www.undergradcatalog.registrar.vt.edu/1617/academic-policies.html#22>)
- 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).

**Statement of Hidden Prerequisites:** Pre-requisites for each course are listed after the course title. Prerequisites may change from what is indicated. Be sure to consult the University Catalog or check with your advisor for the most current requirements. There are no hidden pre-requisites in this program of study.

**Graduation Requirements:** Students must pass all required courses and both the in-major and overall GPA must be at least 2.0 for graduation. No courses on this checksheet may be taken on a Pass/Fail basis.

COLLEGE OF ENGINEERING  
DEPARTMENT OF AEROSPACE AND OCEAN ENGINEERING  
**BACHELOR OF SCIENCE IN AEROSPACE AND OCEAN ENGINEERING, MAJOR: OCEAN ENGINEERING**  
FOR STUDENTS GRADUATING IN CALENDAR YEAR 2020  
128 CREDITS REQUIRED FOR GRADUATION

FRESHMAN FALL SEMESTER 2016		Credits	FRESHMAN SPRING SEMESTER 2017		Credits
CHEM 1035 General Chemistry Co: MATH 1025 or 1225		3	ENGL 1106 First-Year Writing Pre: ENGL 1105		3
CHEM 1045 General Chemistry Lab Co: CHEM 1035		1	MATH 1226 Calculus of a Single Variable Pre: MATH 1225 (C-)		4
ENGL 1105 First-Year Writing		3	PHYS 2305 Foundations of Physics Pre: MATH 1205 or MATH 1205H or MATH 1225 or MATH 1206 or MATH 1206H or MATH 1226; Co: PHYS 2325 or MATH 1206 or MATH 1206H or MATH 1226		4
MATH 1225 Calculus of a Single Variable (C-) Pre: Math Ready		4	ENGE 1216 Foundations of Engineering (C-) Pre: ENGE 1215 (C-)		2
ENGE 1215 Foundations of Engineering (C-)		2	CLE (Area 2, 3, or 7)		3
CLE (Area 2, 3, or 7)		3			
<b>TOTAL</b>		<b>16</b>	<b>TOTAL</b>		<b>16</b>
SOPHOMORE FALL SEMESTER 2017		Credits	SOPHOMORE SPRING SEMESTER 2018		Credits
ESM 2114 <sup>(1)</sup> Statics and Structures Co: MATH 2204 or MATH 2204H or MATH 2406H		3	ESM 2304 <sup>(1)</sup> Dynamics Pre: 2104 or 2114, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H) Co: MATH 2214		3
MATH 2114 <sup>(1)</sup> Introduction to Linear Algebra Pre: MATH 1225 (min grade of B) or MATH 1226		3	MATH 2214 <sup>(1)</sup> Introduction to Differential Equations Pre: 1114 or 1114H or 2114 or 2114H, (1206 or 1226)		3
MATH 2204 <sup>(1)</sup> Introduction to Multivariable Calculus Pre: MATH 1226		3	AOE 2024 <sup>(1)</sup> Thin-Walled Structures Pre: ESM 2114, MATH 2224(H) or MATH 2204(H); Co: MATH 2214		3 <sup>[F, S]</sup>
AOE 2054 <sup>(1)</sup> Electronics for Aerospace and Ocean Engineers		3 <sup>[F]</sup>	PHYS 2306 Foundations of Physics Pre: MATH 1206 or MATH 1206H or MATH 1226, PHYS 2305		4
AOE 2074 <sup>(1)</sup> (ESM 2074) Computational Methods Pre: ENGE 1114 or ENGE 1216 or ENGE 1434		2 <sup>[F, S, SI]</sup>	CLE (Area 3) ECON 2005 Principles of Economics		3
AOE 2204 <sup>(2)</sup> Introduction to Ocean Engineering Pre: ENGE 1216, PHYS 2305; Co: MATH 2204		3 <sup>[F, SI]</sup>	CLE (Area 6)		1
<b>TOTAL</b>		<b>17</b>	<b>TOTAL</b>		<b>17</b>
JUNIOR FALL SEMESTER 2018		Credits	JUNIOR SPRING SEMESTER 2019		Credits
MATH 4564 <sup>(1)</sup> Operational Methods for Engineers Pre: (2214 or 2214H) or 2406H or CMDA 2006		3	GEOS 3034 <sup>(2)</sup> Oceanography Pre: (MATH 1206 or MATH 1226) or (MATH 2015 or MATH 1026)		3
AOE 3014 <sup>(1)</sup> Fluid Dynamics for Aerospace and Ocean Engineers Pre: (2104 or 2204), ESM 2304, MATH 2214		3 <sup>[F]</sup>	AOE 3234 <sup>(2)</sup> Ocean Vehicle Dynamics Pre: 3014, 3034, 3214		3 <sup>[S]</sup>
AOE 3034 <sup>(1)</sup> System Dynamics and Control Pre: ESM 2304, (MATH 2214 or MATH 2214H)		3 <sup>[F]</sup>	AOE 3264 <sup>(2)</sup> Thermodynamics and Marine Propulsion Pre: 2204, 3014		3 <sup>[S]</sup>
AOE 3214 <sup>(2)</sup> Ocean Wave Mechanics Co: 3014, MATH 4564		3 <sup>[F]</sup>	AOE 3054 <sup>(1)</sup> Experimental Methods Pre: 2054, 3014, 3034		3 <sup>[S]</sup>
AOE 3224 <sup>(2)</sup> Ocean Structures Pre: 2024		3 <sup>[F]</sup>	Track Technical Elective		3
<b>TOTAL</b>		<b>15</b>	<b>TOTAL</b>		<b>15</b>
SENIOR FALL SEMESTER 2019		Credits	SENIOR SPRING SEMESTER 2020		Credits
AOE 4205 <sup>(2)</sup> Experiments for Ocean Vehicle Design Pre: 3054; Co: 4265		1 <sup>[F]</sup>	AOE 4206 <sup>(2)</sup> Experiments for Ocean Vehicle Design Pre: 4205; Co: 4266		1 <sup>[S]</sup>
AOE 4265 <sup>(2)</sup> Ocean Vehicle Design Pre: 2204, 3214, 3224, 3234, 3264; Co: 4205		3 <sup>[F]</sup>	AOE 4266 <sup>(2)</sup> Ocean Vehicle Design Pre: 4265; Co: 4206		3 <sup>[S]</sup>
STAT 4705 <sup>(2)</sup> Probability and Statistics for Engineers Pre: MATH 2224 or MATH 2204 or MATH 2204H		3	Track Technical Elective		3
Track Technical Elective		3	Technical Elective		3
Technical Elective		3	Technical Elective		3
CLE (Area 2, 3, or 7)		3	CLE (Area 2, 3, or 7)		3
<b>TOTAL</b>		<b>16</b>	<b>TOTAL</b>		<b>16</b>

**General Information about Checksheet:** Superscripted annotation [F,S,SI,SII] in Credits column indicates terms when a course is expected to be offered. Course offerings are subject to change and the availability of sufficient resources. Students should confirm course offerings in advance with their department. Curriculum for Liberal Education (CLE) courses are shaded in Green. AOE common degree core courses common to AE and OE majors are shaded in Blue and contain a superscripted annotation (1) after the course number. AOE courses specific to OE Major are shaded in Yellow and contain a superscripted annotation (2) after the course number. OE primary majors with an AE secondary major may substitute 4265-4266 for (4065-4066 or 4165-4166) and 4205-4206 for 4105-4106 in their secondary AE major.

**Curriculum for Liberal Education (CLE)**

Consult the CLE Alphabetical Listing at: <http://www.cle.prov.vt.edu/guides/alpha.html>, CLE courses need to be completed prior to graduation

CLE Area 1: Writing and Discourse (6 hrs)	<b>ENGL 1105</b>	<b>(3)</b>	<b>ENGL 1106</b>	<b>(3)</b>
CLE Area 2: Ideas, Cultural Traditions, Values Electives (6 hrs)		<b>(3)</b>		<b>(3)</b>
CLE Area 3: Society & Human Behavior electives (6 hrs)	<b>ECON 2005</b>	<b>(3)</b>		<b>(3)</b>
CLE Area 4: Scientific Reasoning and Discovery (8 hrs)	<b>PHYS 2305</b>	<b>(4)</b>	<b>PHYS 2306</b>	<b>(4)</b>
CLE Area 5: Quantitative and Symbolic Reasoning (8 hrs)	<b>MATH 1225</b>	<b>(4)</b>	<b>MATH 1226</b>	<b>(4)</b>
CLE Area 6: Creativity & Aesthetic Experience elective (1 hr)				<b>(1)</b>
CLE Area 7: Global Issues Elective (3 hrs)				<b>(3)</b>

If a CLE course is double-counted to satisfy two different CLE areas, then a free elective(s) must be taken to maintain a minimum of 128 credits.

**Technical Electives:** The AOE department requires 18 credits of technical electives. *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 OE major. Up to 3 of the 18 credits may be non-AOE technical courses selected either from Tracks or from the attached list of approved non-AOE technical courses.

**Change of Major Requirements:** Please see <http://www.enge.vt.edu/undergraduate-changing-majors.html>

**Foreign Language Requirements:** 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.

**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 (<http://www.undergradcatalog.registrar.vt.edu/1617/academic-policies.html#22><http://www.undergradcatalog.registrar.vt.edu/1617/academic-policies.html#22>)
- 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).

**Statement of Hidden Prerequisites:** Pre-requisites for each course are listed after the course title. Prerequisites may change from what is indicated. Be sure to consult the University Catalog or check with your advisor for the most current requirements. There are no hidden pre-requisites in this program of study.

**Graduation Requirements:** Students must pass all required courses and both the in-major and overall GPA must be at least 2.0 or graduation. No courses on this checksheet may be taken on a Pass/Fail basis.



## AOE DEPARTMENT ELECTIVE REQUIREMENTS For students graduating in calendar year 2020

*AOE students have several types of electives required in their program of study. Listed below are departmental, College and University requirements governing those electives.*

**CURRICULUM FOR LIBERAL EDUCATION (CLE):** Satisfaction of CLE requirements is required of all students in the university. Engineering students satisfy this requirement in Areas 1, 4, and 5 through curricular math, science and English courses. Areas 2, 3, 6, and 7 are satisfied through elective courses; 6 credits are required in Areas 2 and 3, 1 credit in Area 6 and 3 credits in Area 7. The one course required for Area 7 may, if carefully selected, simultaneously satisfy an Area 2 or 3 requirements. Several courses appear on both the Area 2 and Area 6 lists but can be used to satisfy only one of these requirements. Area 7 is the only area in which a course may “double count.” **All CLE requirements must be met with courses taken on an A/F basis unless a course is only offered on the P/F basis.** A link to the *University Curriculum for Liberal Education Guide* is maintained at <http://www.provost.vt.edu/>. Each year, courses may be added to or removed from each Area. A course may be used to satisfy an Area, if it appears on the list of approved courses for that Area during the year it was taken.

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

**MATH ELECTIVE:** All AE students must take MATH 4574 (Vector and Complex Analysis for Engineers), MATH/AOE 4404 (Applied Numerical Methods) or STAT 4705 (Probability and Statistics for Engineers) on an A/F basis. (STAT 4705 is required for OE majors.)

**TECHNICAL ELECTIVES:** The AOE Department requires 18 credits of technical electives, all of which must be taken on an A/F basis. This includes at least 9 credits from one of the approved Tracks. The remaining credits must be AOE courses not otherwise required for AE major. Up to 3 of the 18 credits may be non-AOE technical courses selected either from the Tracks or from the list below. Students pursuing both AE and OE majors may fill all technical elective requirements with required courses from their second major. Courses other than those below may be acceptable as technical electives; however, substitutions must be approved by the AOE Academic Advisor *before the course is taken*. Students are responsible for the satisfaction of prerequisites required for their chosen technical electives.

CEE: 4384, 4674  
CHEM: 4615  
CS: 1044, 1054, 1064, 1114, 1124  
ECE: 1574, 3054, 4164, 4364, 4405, 4406, 4624, 4634, 4644  
ENGE: 2514  
ENGR: 3124  
ESM: 3054 (MSE 3054), 4024, 4044, 4114, 4154, 4194 (ME 4194), 4614  
GEOG: 4354 (GEOS 4354)  
GEOS: 3024, 3034, 4354 (GEOG 4354)  
ISE: 4404  
MSE: 2034, 3054 (ESM 3054), 4055, 4056  
MATH: 3214, 4144, 4225, 4226, 4234, 4245, 4246, 4425, 4426, 4445, 4446, 4574 (if not used as math elective)  
ME: 3134, 4194 (ESM 4194), 4204, 4224, 4504, 4524, 4534, 4624, 4634, 4644, 4724  
MGT: 3304  
NSEG: 3145, 3146  
PHIL: 4324 (MGT 4324)  
PHYS: 3405, 3406, 3655, 3656, 4455, 4456, 4504, 4554, 4614  
STAT: 4105, 4106, 4705 (AE only, if not used as the math elective), 4706

## AEROSPACE AND OCEAN ENGINEERING TECHNICAL TRACKS

For students graduating in calendar year 2020

The AOE department requires 18 credits of technical electives. Students are required to take a minimum of 9 credits from one of the approved Tracks. Up to 3 of the 18 credits may be non-AOE technical courses selected either from Tracks or from the list of approved non-AOE technical courses.

---

### 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 will be available to all Aerospace and Ocean Engineering majors.

**Required: Choose a minimum of 9 credit hours from the following courses.**

Course	Title	CH
AOE 3044	Boundary Layer and Heat Transfer	3
AOE 4004	State-Space Control	3
AOE 4084 (ESM 4084)	Engineering Design Optimization	3
AOE 4324	Energy Methods for Structures	3

**Prerequisites may apply – see your advisor**

---

### 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.

**Required:**

Course	Title	CH
AOE 4324	Energy Methods for Structures	3

**Choose a minimum of 6 credit hours from the following courses**

Course	Title	CH
AOE 4054 (ESM 4444)	Stability of Structures	3
AOE 4024 (ESM 4734)	An Introduction to the Finite Element Method	3
AOE 4274	Intermediate Ship Structural Analysis	3
ESM 3054 (MSE 3054)	Mechanical Behavior of Materials	3
ESM 4024	Advanced Mechanical Behavior of Materials	3
ESM 4044	Mechanics of Composite Materials	3
ME 4624	Finite Element Practice in Mechanical Design	3
MSE 2034	Elements of Materials Engineering	3

**Prerequisites may apply – see your advisor**

---

### 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 will be available to all Aerospace and Ocean Engineering majors.

**Required:**

Course	Title	CH
AOE 3044	Boundary Layer and Heat Transfer	3

**Choose a minimum of 6 credit hours from the following courses.**

Course	Title	CH
AOE 4064	Fluid Flows in Nature	3
AOE 4114	Applied Computational Aerodynamics	3
AOE 4124	Configuration Aerodynamics	3
AOE 4174 (ME 4174)	Spacecraft Propulsion	3
AOE 4434	Introduction to Computational Fluid Dynamics	3
AOE 4474	Propellers and Turbines	3
ME 3134	Fundamentals of Thermodynamics	3

**Prerequisites may apply – see your advisor**

---

### 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 will be available to all Aerospace and Ocean Engineering majors.

**Required:**

Course	Title	CH
AOE 4004	State-Space Control	3

**Choose a minimum of 6 credit hours from the following courses.**

Course	Title	CH
AOE 3134	Air Vehicle Dynamics	3
AOE 3144	Space Vehicle Dynamics	3
AOE 3234	Ocean Vehicle Dynamics	3
AOE 4344	Dynamics of High-Speed Marine Craft	3
AOE 4454	Spacecraft Position/Navigation/Timing and Orbit Determination	3
AOE 4804	Special Topics in Dynamics, Control, and Estimation	3
ECE 4405	Control Systems	3
ECE 4406	Control Systems	3
ECE 4624	Digital Signal Processing and Filter Design	3
ESM 4114	Nonlinear Dynamics and Chaos	3
ME 4534	Land Vehicle Dynamics	3

**Prerequisites may apply – see your advisor.**

---

### 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 will be available to all Aerospace and Ocean Engineering majors.

#### **Required:**

<b>Course</b>	<b>Title</b>	<b>CH</b>
AOE 4084 (ESM 4084)	Engineering Design Optimization	3

Choose a minimum of 6 credit hours from the following courses.

<b>Course</b>	<b>Title</b>	<b>CH</b>
<b><u>AE Major</u></b>		
AOE 4114	Applied Computational Aerodynamics	3
AOE 4124	Configuration Aerodynamics	3
AOE 4174 (ME 4174)	Spacecraft Propulsion	3
AOE 4234 (ME 4234)	Aerospace Propulsion Systems	3
AOE 4414	Computer-Aided Space Mission Planning	1
ME 4644	Introduction to Rapid Prototyping	3
MGT 3304	Management Theory and Leadership	3
PHIL 4324 (MGT 4324)	Business and Professional Ethics	3
<b><u>OE Major</u></b>		
AOE 4244	Naval and Marine Engineering Systems Design	3
AOE 4264	Principles of Naval Engineering	3
ME 4644	Intro to Rapid Prototyping	3
MGT 3304	Management Theory and Leadership	3
PHIL 4324 (MGT 4324)	Business and Professional Ethics	3

**Prerequisites may apply – see your advisor**

---

### 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 skillset. These skills will enable the student to perform research and work in this field. This Track will be available to all Aerospace and Ocean Engineering majors.

#### **Required:**

<b>Course</b>	<b>Title</b>	<b>CH</b>
AOE 4264	Principles of Naval Engineering	3

**Choose a minimum of 6 credit hours from the following courses.**

<b>Course</b>	<b>Title</b>	<b>CH</b>
AOE 4244	Naval and Marine Engineering Systems Design	3
AOE 4274	Intermediate Ship Structural Analysis	3
AOE 4344	Dynamics of High-Speed Marine Craft	3
AOE 4474	Propellers and Turbines	3
ECE 4164	Global Navigation Satellite Systems	3
ECE 4364	Alternate Energy Systems	3
ME 3134	Fundamentals of Thermodynamics	3

**Prerequisites may apply – see your advisor.**

---

### **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 will be available to all Aerospace and Ocean Engineering majors.

**Choose a minimum of 9 credit hours from the following courses.**

<b>Course</b>	<b>Title</b>	<b>CH</b>
AOE 2664 (ECE 2164)	Exploration of the Space Environment	3
AOE 4174 (ME 4174)	Spacecraft Propulsion	3
AOE 4454	Spacecraft Position/Navigation/Timing and Orbit Determination	3
ECE 4164	Introduction to Global Positioning System (GPS) Theory and Design	4
PHYS 3655	Introduction to Astrophysics	3
PHYS 3656	Introduction to Astrophysics	3

**Prerequisites may apply – see your advisor**

---

### **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 will be available to all Aerospace and Ocean Engineering majors.

#### **Tech Elective Courses**

**Choose a minimum of 9 credit hours from the following courses.**

<b>Course</b>	<b>Title</b>	<b>CH</b>
AOE 4174 (ME 4174)	Spacecraft Propulsion	3
AOE 4234 (ME 4234)	Aerospace Propulsion Systems	3
AOE 4474	Propellers and Turbines	3
AOE 4814	Special Topics in Propulsion	3
ME 3134	Fundamentals of Thermodynamics	3
ME 4204	Internal Combustion Engines	3

**Prerequisites may apply – see your advisor**

---

### 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 will be available to all Aerospace and Ocean Engineering majors.

#### Tech Elective Courses

Choose a minimum of 9 credit hours from the following courses.

<b>Course</b>	<b>Title</b>	<b>CH</b>
AOE 4064	Fluid Flows in Nature	3
AOE 4474	Propellers and Turbines	3
AOE 4624	Foundations of Aero/hydroacoustics	3
AOE 4634	Wind Turbine Technology and Aerodynamics	3
AOE 4824	Special Topics in Energy and the Environment	3
ECE 4364	Alternate Energy Systems	3
ENGR 3124	Introduction to Green Engineering	3
ESM 4194 (ME 4194)	Sustainable Energy Solutions for a Global Society	3
ME 3134	Fundamentals of Thermodynamics	3

**Prerequisites may apply – see your advisor**

**TABLE OF AOE TRACKS**  
(See Track Descriptions for Specific Conditions/Requirements)

TRACKS	Structures and Materials	Aero/Hydrodynamics	Dynamics, Control, and Estimation	Vehicle and System Design	Naval Engineering	Space Engineering	Propulsion	Energy and the Environment
<b>Foundational Track</b>								
<b>Foundational Courses</b>	4324 Energy Methods for Structures 4054 (ESM 4444) Stability of Structures 4024 (ESM 4734) Intro to Finite Element Method	3048 Boundary Layer 4064 Fluid Flows in Nature 4114 Applied Computational Aerodynamics	4004 State-Space Control 3134/3144/3234 (Air, Space, Ocean) Vehicle Dynamics 4344 Dynamics of High-Speed Marine Craft	4084 (ESM 4084) Engineering Design Optimization 4114 Applied Computational Aerodynamics 4124 Configuration Aerodynamics	4264 Principles of Naval Engr 4244 Naval and Marine Engineering Systems Design 4274 Intermediate Ship Structural Analysis	2664 (ECE 2164) Space Environment 3744 Aerospace Electronics	4174 (ME 4174) Spacecraft Propulsion Systems 4234 (ME 4234) Aerospace Propulsion Systems 4474 Propellers and Turbines	4064 Fluid Flows in Nature 4474 Propellers and Turbines
<b>Track Courses</b>	4274 Intermediate Ship Structural Analysis ESM 3054 (MSE 3054) Mech Behavior of Materials ESM 4024 Adv Mechanical Behavior: Materials ESM 4044 Mechanics Composite Materials ME 4624 Finite Element Practice MSE 2034 Materials	4124 Configuration Aerodynamics 4174 (ME 4174) Spacecraft Propulsion 4434 Intro CFD 4474 Propellers and Turbines ME 3134: Thermodynamics	4454 Spacecraft PNT/Orbit Det 4804 Special Topics in DC&E ECE 4405-4406 Control Systems ECE 4624 Digital Signal Processing and Filter Design ESM 4114: Nonlinear Dynamics and Chaos ME 4534: Land Vehicle Dynamics	4174 (ME 4174) Spacecraft Propulsion 4234 (ME 4234) Aerospace Propulsion Systems 4244 Naval and Marine Engineering System Design 4264 Principles of Naval Engineering 4414 Computer-Aided Space Mission Planning ME 4644 Intro to Rapid Prototyping MGT 3304 Management Theory and Leadership PHIL 4324 (MGT 4324) Business and Professional Ethics	4344 Dynamics of High-Speed Marine Craft 4474 Propellers and Turbines ECE 4164 Global Navigation Satellite Systems ECE 4364 Alternate Energy Systems ME 3134 Thermodynamics	4454 Spacecraft PNT/Orbit Det ECE 4164 Intro to GPS Theory and Design PHYS 3655/3656 Introduction to Astrophysics	4814 Special Topics in Propulsion ME 3134 Thermodynamics ME 4204 Internal Combustion Engines	4634 Wind Turbine Technology and Aerodynamics 4824 Special Topics in Energy and the Environment ECE 4364 Alternate Energy Systems ENGR 3124 Green Engineering ESM 4194 Sustainable Energy Solution ME 3134 Thermodynamics



College of Engineering

**Academic Affairs**

212 Hancock Hall (0275)  
Blacksburg, Virginia 24061  
540/231-3244 Fax: 540/231-1831  
E-mail: engris@vt.edu  
[http://www.eng.vt.edu/overview/acad\\_affairs.php](http://www.eng.vt.edu/overview/acad_affairs.php)

To: Engineering Undergraduates  
From: Bevee Watford, Associate Dean, Academic Affairs  
Subject: Non-degree credit

DATE: October 2011

Please be aware that not all courses at Virginia Tech will count toward an undergraduate engineering degree. Such courses may not be used to satisfy any graduation requirement, including free electives. Listed below are courses which do not count toward an undergraduate engineering degree. This list is not exhaustive, so if you have any questions, you should check with your engineering department about additional non-credit courses. This list is updated periodically. Be sure to review the list each semester at: [http://www.eng.vt.edu/overview/acad\\_affairs\\_whatwedo.php](http://www.eng.vt.edu/overview/acad_affairs_whatwedo.php)

CS 1004 (Computer Literacy), (no credit awarded to CS majors for these courses: CS 4004, 4014)

UNIV or EDCI 1004 (College Success Strategies), 1014 (Cadet Success Seminar), 1704 (First Year Seminar Course), 2004 (Exploring Careers), 4974 (Independent Study), 2984 (Special Study: Any Subtitle), 4984 (Special Study: Any Subtitle)

EF/ENGE 2984 (Engineering Success Seminar)

ENGL 1004, 0014 (English as a Second Language)

ENGR 3004 Mentoring Seminar; ENGR 4984 (CEED Team Leader Seminar)

ESM 2984 (ESP Statics, Prof Dev Sem for ESM), ESM 4404 (Fundamentals of Professional Engineering)

FCD 2984 (Success Project)

HD 2984 (Healthy Living, Success Project)

MaSc 1024, 1025, 1026 (Mathematics, A Liberal Arts Approach), 1034 (Statistics, A Liberal Arts Approach), 1044 (Computer Science, A Liberal Arts Approach)

MATH 1504 (PreCalc), 2984 (Emerging Scholar), 1015 (Elem Calc with Trig. CS majors may receive 1015 credit if taken before 1205), 1016 (Elementary Calc with Trig), 1525-1526 (Elementary Calc with Matrices), 2015-2016 (Elementary Calc with Trig II)

ME 4984 (SAE Automotive Essentials)

PHYS 2205-2206 (General Physics, not Calc-based)

PSYC 2984 (First Year Experience, Athletic Transitions)

*Invent the Future*

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY  
*An equal opportunity, affirmative action institution*



## MINOR IN NAVAL ENGINEERING (NAVE)

### Department of Aerospace and Ocean Engineering

#### College of Engineering

Check sheet for students graduating in calendar year 2020

Naval Engineering is defined as a field of study and expertise that includes all engineering and sciences as applied in the research, development, design, construction, operation, maintenance and logistic support of surface and subsurface ships, craft, aircraft, and vehicles (manned and autonomous) used by the Navy for the Nation's defense. It inherently includes multiple engineering disciplines, and hence it is open to all students in the College of Engineering who meet the following requirements.

A minor in Naval Engineering consists of not less than 18 semester credit hours. For successful completion of the Minor, students must maintain a 2.0 in-Minor GPA with a minimum grade of C- or better in all courses that the student counts towards the minor.

#### Required:

AOE	2204	Introduction to Ocean Engineering	
AOE	4264	Principles of Naval Engineering	3
AOE	4244	Naval and Marine Engineering System Design	3
or AOE	4994	Undergraduate Research	
or xxx	4994	Undergraduate Research with approved NE focus	—
		<b>Total Credits from Required Courses</b>	<b>9</b>
		<b>Credits Remaining from Below</b>	<b><u>9</u></b>
		<b>Total Required Credits</b>	<b>18</b>

Choose a minimum of nine additional credit hours from the following courses. The broad range and large number of these courses reflects the multiple engineering disciplines inherent in Naval Engineering.

AOE	4265	Ocean Vehicle Design with approved NE focus	3
AOE	4266	Ocean Vehicle Design with approved NE focus	3
XXX	4994	Undergraduate Research w/NE focus (6 w/above)	3
AOE	3134	Air Vehicle Dynamics**	3
AOE	3124	Aerospace Structures**	3
AOE	3154	Astromechanics**	3
AOE	3164	Aerothermo and Propulsion **	3
AOE	3224	Ocean Structures**	3
AOE	3234	Ocean Vehicle Dynamics**	3
AOE	3264	Thermodynamics and Marine Propulsion**	3
AOE	4234	Aerospace Propulsion Systems **	3
CEE	3104	Introduction to Environmental Engineering	3

CHE	2164	Chemical Engineering Thermodynamics	3
CHE	3184	Chemical Reactor Analysis and Design**	3
CHE	4134	Chemical Process Modeling**	2
CS	3724	Introduction to Human-Computer Interaction**	3
CS	3114	Data Structures and Algorithms**	3
CS	3204	Operating Systems**	3
CS	3304	Comparative Languages**	3
ECE	3054	Electrical Theory**	3
ECE	3304	Introduction to Power Systems**	3
ECE	4224	Power Electronics**	3
ECE	3574	Applied Software Engineering**	3
ECE	2704	Signals and Systems	3
ECE	3504	Digital Design I**	4
ECE	2500	Computer Organization & Architecture	3
ESM	2204	Mechanics of Deformable Bodies	3
ESM	3015	Fluid Mechanics I, II	3
ESM	3054/3064	Mechanical Behavior of Materials	3
ESM	4044	Mechanics of Composite Materials**	3
ESM	4734 (AOE 4024)	An Introduction To The Finite Element Method**	3
ISE	3614	Intro to Human Factors Engineering	3
ISE	2014	Engineering Economy	2
ISE	2404	Deterministic Operations Research	3
ISE	3414	Probabilistic Operations Research**	3
ISE	3624	Industrial Ergonomics	3
ISE	4005	Project Management and System Design**	3
ME	3124	Thermodynamics	3
ME	3304	Heat and Mass Transfer	3
ME	3404	Fluid Mechanics	3
ME	3514	System Dynamics	3
ME	4124	CAD of Fluid-Thermal Systems**	3
MSE	4164	Principles of Materials Corrosion	3
MSE	4034	Thermodynamics of Materials**	3
MSE	3054/3064	Mechanical Behavior of Materials	2
MSE	4354	Strength and Fracture**	1

**\*\* Prerequisites may apply – see your advisor**

This minor supports the requirements of the Naval Engineering Education Consortium (NEEC) in which students may also participate. The consortium provides opportunities for industry and US Navy mentors, projects, internships, co-ops and job opportunities.