

CLASS OF 2017

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 in Aerospace Engineering or Ocean Engineering 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.

THE ATTACHED COURSE MATERIAL MAY NOT MATCH THE UNIVERSITY CATALOG LISTING OF OUR CURRICULA. THIS MATERIAL IS YOUR OFFICIAL LISTING OF GRADUATION REQUIREMENTS.

In the following material you will find up-to-date versions of our academic requirements, including curricular listings for those of you who want to pursue double majors in AE and OE. **It is very important that you keep this information.**

Please note that 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. The university Curriculum for Liberal Education (CLE) requirements are, on the other hand, based on *date of entry*. *Should you at any point fall behind your previously planned graduation date you should see your advisor to make sure that delay does not cause you any problems in meeting graduation requirements.* Also be aware that the 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.

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.

By the way, 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.

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 e-mail. The department maintains e-mail 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 e-mail – it could be important!*

C-MINUS RULE: The AOE Department requires that students earn a minimum grade of C-minus in all courses that are prerequisites to required AOE courses. The purpose of this policy is to help identify those students who may have difficulty with curricular material before those problems build up and ultimately prevent graduation.

The university requires that all students maintain a 2.0 overall GPA for academic eligibility and for graduation. Students must also have an average GPA of 2.0 in their major (all AOE courses) in order to graduate. Students who enter the senior year with an in-major GPA below 2.0 will find it difficult to attain the required minimum for graduation. For this reason, students who do not show satisfactory academic progress by maintaining a 2.0 in-major GPA will be placed on probation and may be suspended after two semesters of failing to reach a 2.0 in-major GPA (University Policy 91). The simple rule is that every D grade must be balanced with a B grade.

ADVISING AND REGISTRATION: Every student in AOE is assigned an academic advisor who should be able to help him or her with course registration, curricular planning or with any other matter. 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 it 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 to review their DARS 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 Dr. Canfield.*

Many students end up taking additional courses beyond the 135 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, which are only offered once each year. The result can be a full year delay in graduation due to dropping a single course!

CAREER 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. Ms. 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.

CO-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. Co-op is an excellent way to gain valuable “real world” experience, earn extra money and line up a job upon graduation. Ms. Madhu Kapania is the department’s Co-op advisor. Interested students should begin by contacting the Career Services Office.

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 six hours of classes 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. The double major can be earned with as little as two extra credits of coursework. Programs of study for double majors from both the AE and the OE perspective are listed in the following material. A double major only receives a diploma in the program listed as the “first” major, 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 135 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). *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 will 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 Aircraft Design, 4165-66 Spacecraft Design, and AOE 4265-66 Ship 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 Spacecraft Design has a prerequisite of AOE 4140 Spacecraft Dynamics and Control, which has a prerequisite of AOE 4134 Astromechanics. Therefore, students wishing to take Spacecraft Design must take AOE 4134 in the fall of the junior year and must take AOE 4140 instead of AOE 3134 in the spring of the junior year. Students wishing to take Aircraft Design must take AOE 3134 in the spring of the junior 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 and Woolsey are 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. Both AE and OE students are invited to join. Dr. Seidel is the faculty advisor.

College of Engineering
Department of Aerospace and Ocean Engineering
BACHELOR OF SCIENCE IN AEROSPACE ENGINEERING
For students graduating in calendar year 2016

FRESHMAN YEAR

FALL			SPRING		
CHEM	1035	GENERAL CHEMISTRY	3		
CHEM	1045	GENERAL CHEMISTRY LAB	1	ENGE	1114 EXPLORATION OF ENGINEERING DESIGN ¹ 2
ENGE	1024	ENGINEERING EXPLORATION ¹	2	ENGL	1106 FIRST-YEAR WRITING 3
ENGL	1105	FIRST-YEAR WRITING	3	MATH	1206 CALCULUS 3
MATH	1114	ELEMENTARY LINEAR ALGEBRA	2	MATH	1224 VECTOR GEOMETRY 2
MATH	1205	CALCULUS	3	PHYS	2305 FOUNDATIONS OF PHYSICS I 4
ELECTIVE*			<u>3</u>	ELECTIVE*	<u>3</u>
			17		17

SOPHOMORE YEAR

FALL			SPRING		
AOE	2074	COMPUTATIONAL METHODS	3	AOE	3094 MATERIALS FOR AERO & OCEAN ENG 3
AOE	2104	INTRO TO AEROSPACE ENG	3	AOE	3104 AIRCRAFT PERFORMANCE 3
ESM	2104	STATICS	3	ESM	2204 MECH OF DEFORMABLE BODIES 3
MATH	2224	MULTIVARIABLE CALCULUS	3	ESM	2304 DYNAMICS 3
PHYS	2306	FOUNDATIONS OF PHYSICS I	<u>4</u>	MATH	2214 INTRO DIFF EQUATIONS 3
			16	ELECTIVE*	<u>3</u>
					18

JUNIOR YEAR

FALL			SPRING		
AOE	3014	AERO/HYDRODYNAMICS	3	AOE	3054 AOE EXPERIMENTAL METHODS 3
AOE	3024	THIN-WALLED STRUCTURES	3	AOE	3114 COMPRESSIBLE AERODYNAMICS 3
AOE	3034	VEHICLE VIBRATION AND CONTROL	3	AOE	3124 AEROSPACE STRUCTURES 3
MATH	4564	OPERATIONAL METHODS	3	AOE	3134 STABILITY & CONTROL 3
ME	3134	FUND OF THERMODYNAMICS	3	OR	
ELECTIVE*			<u>3</u>	AOE	4140 SPACECRAFT DYNAMICS & CONTROL 3
	OR			MATH ELECTIVE+	3
AOE	4134	ASTROMECHANICS	3	ELECTIVE*	<u>3</u>
			18		18

+ Choice of Math 4574 (Vector and Complex Analysis for Engineers) or Math/AOE 4404 (Applied Numerical Methods) or Stat 4705 (Probability and Statistics for Engineers)

SENIOR YEAR

FALL			SPRING		
AOE	3044	BOUNDARY LAYER THEORY	3	AOE	4x66 AIRCRAFT OR SPACECRAFT DESIGN II** 3
AOE	4x65	AIRCRAFT OR SPACECRAFT DESIGN I**	3	ELECTIVES*	6
AOE	4134	ASTROMECHANICS	3	AOE TECHNICAL ELECTIVES++	<u>6</u>
	OR	(opposite of Junior yr. choice)	3		15
ELECTIVE*					
AOE	4154	AERO ENGR LAB	1		
AOE	4234	AEROSPACE PROPULSION SYSTEMS	3		
TECHNICAL ELECTIVES++			<u>3</u>		
			16		

In order to enter this restricted major, students must have:

- 1) A competitive GPA of at least 2.0 or higher;
- 2) A minimum grade of C- or better in ENGE 1024 and ENGE 1114 (or ENGE 1434); and
- 3) Credit for MATH 1205, 1206, 1114, 1224; CHEM 1035/1045; ENGL 1105, 1106; PHYS 2305.

Satisfactory Progress: In addition to the requirements of University Policy 91, after attempting 72 credit hours, students must have passed AOE 3104, and after attempting 108 credit hours, students must have passed 24 credit hours of in-major courses and have 2.0 overall and in-major GPAs.

¹ ENGE 1434 (5 cr.) may be substituted for ENGE 1024 and ENGE 1114.

* Electives include 6 credits each from Curriculum for Liberal Education (CLE) Areas 2 and 3, 1 credit from CLE Area 6, and 3 credits from CLE Area 7 (the area 7 course may double count with area 2 or 3). *The AOE Department requires that Econ 2005 (Principles of Economics) be one of the courses taken in Area 3.* Three to eight credits will be free electives.

** AE MAJORS MAY TAKE EITHER 4065-4066 AIRCRAFT DESIGN OR 4165-4166 SPACECRAFT DESIGN.

++ The AOE Department requires 9 credits of technical electives of which 6 credits must be an AOE 3000 level or higher course and the remaining 3 may be selected from a list of computer programming courses and other, 3000 level or higher, approved technical courses.

THERE ARE NO HIDDEN PREREQUISITES IN THIS PROGRAM OF STUDY.

Students must have had 2 years of a foreign language in high school or one year at the college level. College-level credits used to meet this requirement do not count towards the degree. The "in-major GPA" consists of all courses taken under the AOE designation. Students must pass all required courses and both the in-major and overall GPA must be at least 2.0 for graduation. Only free electives and courses only offered on a Pass/Fail basis may be taken Pass/Fail.

135 CREDITS ARE REQUIRED FOR GRADUATION.

NOTE: Courses on the College of Engineering list of non-degree credit may not be taken for credit towards graduation.

College of Engineering
Department of Aerospace and Ocean Engineering
BACHELOR OF SCIENCE IN OCEAN ENGINEERING
For students graduating in calendar year 2016

FRESHMAN YEAR							
FALL			SPRING				
CHEM	1035	GENERAL CHEMISTRY	3				
CHEM	1045	GENERAL CHEMISTRY LAB	1	ENGE	1114	EXPLORATION OF ENGINEERING DESIGN ¹	2
ENGE	1024	ENGINEERING EXPLORATION ¹	2	ENGL	1106	FIRST-YEAR WRITING	3
ENGL	1105	FIRST-YEAR WRITING	3	MATH	1206	CALCULUS	3
MATH	1114	ELEMENTARY LINEAR ALGEBRA	2	MATH	1224	VECTOR GEOMETRY	2
MATH	1205	CALCULUS	3	PHYS	2305	FOUNDATIONS OF PHYSICS I	4
ELECTIVE*			<u>3</u>	ELECTIVE*			<u>3</u>
			17				17

SOPHOMORE YEAR							
FALL			SPRING				
AOE	2074	COMPUTATIONAL METHODS	3	AOE	3094	MATERIALS FOR AERO & OCEAN ENG	3
AOE	2204	INTRO TO OCEAN ENGINEERING	3	AOE	3204	NAVAL ARCHITECTURE	3
ESM	2104	STATICS	3	ESM	2204	MECHANICS OF DEFORMABLE BODIES	3
MATH	2224	MULTIVARIABLE CALCULUS	3	ESM	2304	DYNAMICS	3
PHYS	2306	FOUNDATIONS OF PHYSICS I	4	MATH	2214	INTRO DIFF EQUATIONS	3
			<u>16</u>	ELECTIVE*			<u>3</u>
							18

JUNIOR YEAR							
FALL			SPRING				
AOE	3014	AERO/HYDRODYNAMICS	3	AOE	3054	AOE EXPERIMENTAL METHODS	3
AOE	3024	THIN-WALLED STRUCTURES	3	AOE	3224	OCEAN STRUCTURES	3
AOE	3034	VEHICLE VIBRATION AND CONTROL	3	AOE	3264	RESISTANCE & PROPULSION OF SHIPS	3
MATH	4564	OPERATIONAL METHODS	3	AOE	4214	OCEAN WAVE MECHANICS	3
ME	3134	FUNDAMENTALS OF THERMODYNAMICS	3	AOE	4244	MARINE ENGINEERING	3
ELECTIVE*			<u>3</u>	STAT	4705	PROBABILITY AND STATISTICS FOR ENGINEERS	<u>3</u>
			18				18

SENIOR YEAR							
FALL			SPRING				
AOE	3044	BOUNDARY LAYER THEORY	3	AOE	4266	SHIP DESIGN II	3
AOE	4265	SHIP DESIGN I	3	TECHNICAL ELECTIVES++			3
AOE	4254	OCEAN ENGINEERING LABORATORY	1	ELECTIVES*			<u>9</u>
AOE	4334	SHIP DYNAMICS	3				15
TECHNICAL ELECTIVES++			<u>6</u>				
			16				

In order to enter this restricted major, students must have:

- 1) A competitive GPA of at least 2.0 or higher;
- 2) A minimum grade of C- or better in ENGE 1024 and ENGE 1114 (or ENGE 1434); and
- 3) Credit for MATH 1205, 1206, 1114, 1224; CHEM 1035/1045; ENGL 1105, 1106; PHYS 2305.

Satisfactory Progress: In addition to the requirements of University Policy 91, after attempting 72 credit hours, students must have passed AOE 3204, and after attempting 108 credit hours, students must have passed 24 credit hours of in-major courses and have 2.0 overall and in-major GPAs.

¹ ENGE 1434 (5 cr.) may be substituted for ENGE 1024 and ENGE 1114.

* Electives include 6 credits each from Curriculum for Liberal Education (CLE) Areas 2 and 3, 1 credit from CLE Area 6, and 3 credits from CLE Area 7 (the area 7 course may double count with area 2 or 3). *The AOE Department requires that Econ 2005 (Principles of Economics) be one of the courses taken in Area 3.* Three to eight credits will be free electives.

++ The AOE Department requires 9 credits of technical electives of which 6 credits must be an AOE 3000 level or higher course and the remaining 3 may be selected from a list of computer programming courses and other, 3000 level or higher, approved technical courses.

THERE ARE NO HIDDEN PREREQUISITES IN THIS PROGRAM OF STUDY

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

The "in-major GPA" consists of all courses taken under the AOE designation.

Students must pass all required courses and both the in-major and overall GPA must be at least 2.0 for graduation.

Only free electives and courses only offered on a Pass/Fail basis may be taken Pass/Fail.

135 CREDITS ARE REQUIRED FOR GRADUATION.

NOTE: Courses on the College of Engineering list of non-degree credit may not be taken for credit towards graduation.

College of Engineering, Department of Aerospace and Ocean Engineering
BACHELOR OF SCIENCE IN AEROSPACE ENGINEERING
WITH A DOUBLE MAJOR IN OCEAN ENGINEERING
For students graduating in calendar year 2016

FRESHMAN YEAR							
FALL			SPRING				
CHEM	1035	GENERAL CHEMISTRY	3				
CHEM	1045	GENERAL CHEMISTRY LAB	1	ENGE	1114	EXPLORATION OF ENGINEERING DESIGN ¹	2
ENGE	1024	ENGINEERING EXPLORATION ¹	2	ENGL	1106	FIRST-YEAR WRITING	3
ENGL	1105	FIRST-YEAR WRITING	3	MATH	1206	CALCULUS	3
MATH	1114	ELEMENTARY LINEAR ALGEBRA	2	MATH	1224	VECTOR GEOMETRY	2
MATH	1205	CALCULUS	3	PHYS	2305	FOUNDATIONS OF PHYSICS I	4
ELECTIVE*			<u>3</u>	ELECTIVE*			<u>3</u>
			17				17

SOPHOMORE YEAR							
FALL			SPRING				
AOE	2074	COMPUTATIONAL METHODS	3	AOE	3094	MATERIALS FOR AERO & OCEAN ENG	3
AOE	2104	INTRO TO AEROSPACE ENG	3	AOE	3104	AIRCRAFT PERFORMANCE	3
ESM	2104	STATICS	3	AOE	3204	NAVAL ARCHITECTURE	3
MATH	2224	MULTIVARIABLE CALCULUS	3	ESM	2204	MECHANICS OF DEFORMABLE BODIES	3
PHYS	2306	FOUNDATIONS OF PHYSICS I	<u>4</u>	ESM	2304	DYNAMICS	3
			16	MATH	2214	INTRO DIFF EQUATIONS	<u>3</u>
							18

JUNIOR YEAR							
FALL			SPRING				
AOE	3014	AERO/HYDRODYNAMICS	3	AOE	3054	AOE EXPERIMENTAL METHODS	3
AOE	3024	THIN-WALLED STRUCTURES	3	AOE	3114	COMPRESSIBLE AERODYNAMICS	3
AOE	3034	VEHICLE VIBRATION AND CONTROL	3	AOE	3124	AEROSPACE STRUCTURES	3
AOE	4134	ASTROMECHANICS	3	AOE	3134	STABILITY & CONTROL	3
MATH	4564	OPERATIONAL METHODS	3	OR			3
ME	3134	FUNDAMENTALS OF THERMODYNAMICS	<u>3</u>	AOE	4140	SPACECRAFT DYNAMICS & CONTROL	3
			18	AOE	3264	RESISTANCE & PROPULSION OF SHIPS	3
				AOE	4214	OCEAN WAVE MECHANICS	<u>3</u>
							18

SUMMER SESSION: ELECTIVES* 1-4cr AS NEEDED TO COMPLETE THE CURRICULUM FOR LIBERAL EDUCATION

SENIOR YEAR							
FALL			SPRING				
AOE	3044	BOUNDARY LAYER THEORY	3	AOE	3224	OCEAN STRUCTURES	3
AOE	4334	SHIP DYNAMICS	3	AOE	4x66	AIRCRAFT OR SPACECRAFT DESIGN II**	3
AOE	4x65	AIRCRAFT OR SPACECRAFT DESIGN I**	3	AOE	4244	MARINE ENGINEERING	3
AOE	4234	AEROSPACE PROPULSION SYSTEMS	3	STAT	4705	PROBABILITY AND STATISTICS FOR ENGINEERS	3
AOE	4154	AERO ENGR LAB	1	ELECTIVES*			<u>3</u>
AOE	4254	OCEAN ENGINEERING LABORATORY	1				15
ELECTIVES*			<u>3</u>				
			17				

In order to enter this restricted major, students must have:

- 1) A competitive GPA of at least 2.0 or higher;
- 2) A minimum grade of C- or better in ENGE 1024 and ENGE 1114 (or ENGE 1434); and
- 3) Credit for MATH 1205, 1206, 1114, 1224; CHEM 1035/1045; ENGL 1105, 1106; PHYS 2305.

Satisfactory Progress: In addition to the requirements of University Policy 91, after attempting 72 credit hours, students must have passed AOE 3104, and after attempting 108 credit hours, students must have passed 24 credit hours of in-major courses and have 2.0 overall and in-major GPAs.

¹ ENGE 1434 (5 cr.) may be substituted for ENGE 1024 and ENGE 1114.

* Electives include 6 credits each from Curriculum for Liberal Education (CLE) Areas 2 and 3, 1 credit from CLE Area 6, and 3 credits from CLE Area 7 (the area 7 course may double count with area 2 or 3). *The AOE Department requires that Econ 2005 (Principles of Economics) be one of the courses taken in Area 3.* There are no free electives.

** AE DOUBLE MAJORS MAY TAKE EITHER 4065-4066 AIRCRAFT DESIGN OR 4165-4166 SPACECRAFT DESIGN.

THERE ARE NO HIDDEN PREREQUISITES IN THIS PROGRAM OF STUDY.

Students must have had 2 years of a foreign language in high school or one year at the college level. College-level credits used to meet this requirement do not count towards the degree. The "in-major GPA" consists of all courses taken under the AOE designation. Students must pass all required courses and both the in-major and overall GPA must be at least 2.0 for graduation. Only free electives and courses only offered on a Pass/Fail basis may be taken Pass/Fail. 137-140 CREDITS ARE REQUIRED FOR GRADUATION.

NOTE: Courses on the College of Engineering list of non-degree credit may not be taken for credit towards graduation

College of Engineering
Department of Aerospace and Ocean Engineering
BACHELOR OF SCIENCE IN OCEAN ENGINEERING
WITH A DOUBLE MAJOR IN AEROSPACE ENGINEERING
For students graduating in calendar year 2016

FRESHMAN YEAR

FALL			SPRING		
CHEM	1035	GENERAL CHEMISTRY	3		
CHEM	1045	GENERAL CHEMISTRY LAB	1	ENGE	1114 EXPLORATION OF ENGINEERING DESIGN ¹ 2
ENGE	1024	ENGINEERING EXPLORATION ¹	2	ENGL	1106 FIRST-YEAR WRITING 3
ENGL	1105	FIRST-YEAR WRITING	3	MATH	1206 CALCULUS 3
MATH	1114	ELEMENTARY LINEAR ALGEBRA	2	MATH	1224 VECTOR GEOMETRY 2
MATH	1205	CALCULUS	3	PHYS	2305 FOUNDATIONS OF PHYSICS I 4
ELECTIVE*			<u>3</u>	ELECTIVE*	<u>3</u>
			17		17

SOPHOMORE YEAR

FALL			SPRING		
AOE	2074	COMPUTATIONAL METHODS	3	AOE	3094 MATERIALS FOR AERO & OCEAN ENG 3
AOE	2204	INTRO TO OCEAN ENGINEERING	3	AOE	3104 AIRCRAFT PERFORMANCE 3
ESM	2104	STATICS	3	AOE	3204 NAVAL ARCHITECTURE 3
MATH	2224	MULTIVARIABLE CALCULUS	3	ESM	2204 MECHANICS OF DEFORMABLE BODIES 3
PHYS	2306	FOUNDATIONS OF PHYSICS I	<u>4</u>	ESM	2304 DYNAMICS 3
			16	MATH	2214 INTRO DIFF EQUATIONS <u>3</u>
					18

JUNIOR YEAR

FALL			SPRING		
AOE	3014	AERO/HYDRODYNAMICS	3	AOE	3054 AOE EXPERIMENTAL METHODS 3
AOE	3024	THIN-WALLED STRUCTURES	3	AOE	3114 COMPRESSIBLE AERODYNAMICS 3
AOE	3034	VEHICLE VIBRATION AND CONTROL	3	AOE	3224 OCEAN STRUCTURES 3
AOE	4134	ASTROMECHANICS	3	AOE	3264 RESISTANCE & PROPULSION OF SHIPS 3
MATH	4564	OPERATIONAL METHODS	3	AOE	4214 OCEAN WAVE MECHANICS 3
ME	3134	FUNDAMENTALS OF THERMODYNAMICS	<u>3</u>	AOE	4244 MARINE ENGINEERING <u>3</u>
			18		18

SUMMER SESSION: ELECTIVES* 1-4cr AS NEEDED TO COMPLETE THE CURRICULUM FOR LIBERAL EDUCATION

SENIOR YEAR

FALL			SPRING		
AOE	3044	BOUNDARY LAYER THEORY	3	AOE	3124 AEROSPACE STRUCTURES 3
AOE	4265	SHIP DESIGN I	3	AOE	3134 STABILITY & CONTROL 3
AOE	4234	AEROSPACE PROPULSION SYSTEMS	3	OR	
AOE	4154	AERO ENGR LAB	1	AOE	4140 SPACECRAFT DYNAMICS & CONTROL 3
AOE	4254	OCEAN ENGINEERING LABORATORY	1	AOE	4266 SHIP DESIGN II 3
AOE	4334	SHIP DYNAMICS	3	STAT	4705 PROBABILITY AND STATISTICS FOR ENGINEERS 3
ELECTIVES*			<u>3</u>	ELECTIVES*	<u>3</u>
			17		15

In order to enter this restricted major, students must have:

- 1) A competitive GPA of at least 2.0 or higher;
- 2) A minimum grade of C- or better in ENGE 1024 and ENGE 1114 (or ENGE 1434); and
- 3) Credit for MATH 1205, 1206, 1114, 1224; CHEM 1035/1045; ENGL 1105, 1106; PHYS 2305.

Satisfactory Progress: In addition to the requirements of University Policy 91, after attempting 72 credit hours, students must have passed AOE 3204, and after attempting 108 credit hours, students must have passed 24 credit hours of in-major courses and have 2.0 overall and in-major GPAs.

¹ ENGE 1434 (5 cr.) may be substituted for ENGE 1024 and ENGE 1114.

* Electives include 6 credits each from Curriculum for Liberal Education (CLE) Areas 2 and 3, 1 credit from CLE Area 6, and 3 credits from CLE Area 7 (the area 7 course may double count with area 2 or 3). *The AOE Department requires that Econ 2005 (Principles of Economics) be one of the courses taken in Area 3.* There are no free electives.

THERE ARE NO HIDDEN PREREQUISITES IN THIS PROGRAM OF STUDY.

Students must have had 2 years of a foreign language in high school or one year at the college level. College-level credits used to meet this requirement do not count towards the degree. The "in-major GPA" consists of all courses taken under the AOE designation. Students must pass all required courses and both the in-major and overall GPA must be at least 2.0 for graduation. Only free electives and courses only offered on a Pass/Fail basis may be taken Pass/Fail. 137-140 CREDITS ARE REQUIRED FOR GRADUATION.

NOTE: Courses on the College of Engineering list of non-degree credit may not be taken for credit towards graduation

To: Engineering Undergraduates
From: Bevlee 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

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

AOE DEPARTMENT ELECTIVE POLICIES AND REQUIREMENTS
For students graduating in calendar year 2016

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.

VISUAL EXPRESSION, WRITING AND SPEAKING (ViEWS) Requirement (Writing Intensive requirement)

The ViEWS (or Writing Intensive) requirement will be met by taking the required senior level design courses (AOE 4x65 and 4x66) in the major.

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

TECHNICAL ELECTIVES: The AOE Department requires 9 credits of technical electives, all of which must be taken on an A/F basis. This includes 6 credits of AOE courses at the 3000 level or above and 3 credits 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, any substitutions must be approved by the student’s course advisor **before the course is taken**. Students are responsible for the satisfaction of prerequisites required for their chosen technical electives.

- AOE: Any 3000 or higher level course not required in the student’s major
- CEE: 4674
- CHEM: 4615
- CS: 1044, 1054, 1064, 1114, 1124
- ECE: 3054, 4164, 4405, 4406, 4624, 4634, 4644
- ENGE: 2514
- ENGR: 3124
- ESM: 3054, 4024, 4044, 4114, 4154, 4614, 4714
- GEOG: 4354
- GEOS: 3114, 3034
- ISE: 4404
- MSE: 4055, 4056
- MATH: 3214, 4144, 4225, 4226, 4234, 4245, 4246, 4425, 4426, 4445, 4446, 4574 (if not used as math elective)
- ME: 4204, 4224, 4254, 4504, 4514, 4524, 4534, 4634, 4644, 4704, 4724, 4734
- NSEG: 3145, 3146
- PHYS: 3405, 3406, 3655, 3656, 4455, 4456, 4504, 4554, 4614
- STAT: 4105, 4106, 4705 (AE only, if not used as the math elective), 4706

FREE ELECTIVES may be any course you care to take (with the exception of the non-degree credit courses in the attached list) including PE, ROTC, Band, etc. If you have transfer credits or AP credit that did not satisfy one of your curriculum requirements, these may be used as free elective credits. Free electives may be taken on P/F basis provided the student meets the requirements for taking courses P/F and the course is offered on that basis.

**Course Prerequisites
Aerospace and Ocean Engineering**

Semester	Course	Pre(Co)requisite	Pre(Co)requisite For
1 st Yr Fall			
	CHEM 1035 Gen Chemistry I		AOE 3094, Co: CHEM 1045
	CHEM 1045 Chemistry Lab I	Co: CHEM 1035	
	ENGE 1024 Engineering Exploration	Co: MATH 1205	ENGE 1114
	ENGL 1105 English I		ENGL 1106
	MATH 1205 Calculus I		MATH 1206, 1224, PHYS 2305, Co: ENGE 1024
	MATH 1114 Linear Algebra		ESM 2104, Co: MATH 1224
1 st Yr Spring			
	ENGE 1114 Explor of Engr Design	ENGE 1024	AOE 2074, 2104, 2204
	ENGL 1106 English II	ENGL 1105	
	MATH 1206 Calculus II	MATH 1205	MATH 2224, PHYS 2306 Co: MATH 1224, PHYS 2305
	MATH 1224 Vector Geometry	MATH 1205, CO: MATH 1114, 1206	MATH 2224
	PHYS 2305 Physics I	MATH 1205, Co: MATH 1206	AOE 2104, 2204, PHYS 2306, Co: AOE 3094
2 nd Yr Fall			
	AOE/ESM 2074 Comp Methods	ENGE 1114, Co: MATH 2224	Co: AOE 3104, 3204
(AE)	AOE 2104 Intro to Aerospace Engr	ENGE 1114, PHYS 2305	AOE 3104, 3204
(OE)	AOE 2204 Intro to Ocean Engr	ENGE 1114, PHYS 2305	AOE 3104, 3204
	ESM 2104 Statics	MATH 1114, Co: MATH 2224	AOE 3024, 3104, 3204
	MATH 2224 Multivariable Calculus	MATH 1206, MATH 1224	AOE 3204, ESM 2204, ESM 2304, STAT 4705, Co: AOE 2074, ESM 2104
	PHYS 2306 Physics II	MATH 1206, PHYS 2305	
2 nd Yr Spring			
	AOE 3094 AOE Materials	CHEM 1035, Co: ESM 2204, PHYS 2305	
(AE)	AOE 3104 Aircraft Performance	AOE 2104 or 2204; Co: 2074; ESM 2104, Co: ESM 2304	All 3000 & higher level AOE courses
(OE)	AOE 3204 Naval Architecture	AOE 2104 or 2204; Co: 2074; ESM 2104, MATH 2224, Co: ESM 2304	All 3000 & higher level AOE courses
	ESM 2204 Mech of Def Bodies	ESM 2104, MATH 2224	AOE 3024, Co: AOE 3094
	ESM 2304 Dynamics	ESM 2104, MATH 2224, Co: MATH 2214	AOE 3014, 3034, 4134, Co: AOE 3104, 3204
	MATH 2214 Differential Equations	MATH 1114, 1206	AOE 3034, MATH 4564, ME 3134, Co: ESM 2304

(continued on next page)

Course Prerequisites (continued)
Aerospace and Ocean Engineering

Semester	Course	Pre(Co)requisite	Pre(Co)requisite For
3 rd Yr Fall			
	AOE 3014 Aero/Hydrodynamics	AOE 3104 or 3204, ESM 2304	AOE 3054, 3044, 3114, 3264, 4214, 4334
	AOE 3024 Thin-Wall Structures	ESM 2104, ESM 2204	AOE 3054, 3124, 3224
	AOE 3034 Vibration & Control	ESM 2304, Math 2214	AOE 3054, 3134, 4140, 4334
(AE)	AOE 4134 Astromechanics	ESM 2304	AOE 4140
	MATH 4564 Oper Methods for Engr	Math 2214	AOE 3044, 4214, 4334
	ME 3134 Thermodynamics	Math 2214	AOE 3044, 3114, 4234, 4244
3 rd Yr Spring			
	AOE 3054 Exp. Methods	AOE 3014, 3024, 3034	AOE 4154, 4254, 4x65
(AE)	AOE 3114 Compressible Aerodyn	AOE 3014, ME 3134	AOE 4154, 4234, 4065, 4165
(AE)	AOE 3124 A/C Structures	AOE 3024	AOE 4154, 4065, 4165
(AE)	AOE 3134 Stability & Control	AOE 3034	AOE 4154, 4065
(OE)	AOE 3224 Ocean Structures	AOE 3024	AOE 4265
(OE)	AOE 3264 Resist & Propulsion	AOE 3014, 3204	AOE 4254, 4265
(AE)	AOE 4140 Spacecraft Dynamics & Control	AOE 3034, 4134	AOE 4165, 4154
(OE)	AOE 4214 Ocean Wave Mechanics	AOE 3014, MATH 4564	AOE 4334, 4265
(OE)	AOE 4244 Marine Engineering	AOE 3204, ME 3124 or 3134	AOE 4265
(OE)	STAT 4705 Prob & Statistics For Engr	MATH 2224	
4 th Yr Fall			
	AOE 3044 Boundary Layer & Heat Transfer	AOE 3014, MATH 4564, ME 3134	
(AE)	AOE 4065 Aircraft Design I	AOE 3054, 3114, 3124, 3134	AOE 4066
(AE)	AOE 4165 Spacecraft Design I	AOE 3054, 3114, 3124, 4140	AOE 4166
(OE)	AOE 4265 Ship Design I	AOE 3054, 3224, 3264, 4214, 4244; Co: AOE 4334	AOE 4266
(AE)	AOE 4134 Astromechanics	ESM 2304	AOE 4140
(AE)	AOE 4154 Aerospace Engineering Lab	AOE 3054, 3114, 3124, 3134 or 4140	
(AE)	AOE 4234 Aerospace Propulsion	AOE 3114, ME 3134	
(OE)	AOE 4254 OE Lab	AOE 3054, 3264	
(OE)	AOE 4334 Ship Dynamics	AOE 3014, 3034, 4214, MATH 4564	AOE 4265
4 th Yr Spring			
(AE)	AOE 4066 Aircraft Design II	AOE 4065	
(AE)	AOE 4166 Spacecraft Design II	AOE 4165	
(OE)	AOE 4266 Spacecraft Design II	AOE 4265	

AOE ELECTIVE CHECK SHEET

AE and OE majors are required to take 33 credits of electives. This includes nine credits of technical electives, a three credit Math elective (OE majors must take Stat 4705 as their math elective), and twenty-two other credits including Areas 2, 3, 6, and 7 of the University's CLE courses and three to eight credits of "free electives". All electives except "free electives" must be taken for a grade unless the course is offered P/F only.

TECHNICAL ELECTIVES: *Six credits must be 3000 level or higher AOE courses which are not otherwise required in the student's major and three credits can be a computer programming elective or 3000 level or higher courses in or out of AOE from the AOE Technical Elective List.*

AOE Technical Electives: _____, _____ **6 cr**

Other Tech. Electives:

Programming Elective: CS 1044, CS 1054, CS 1114, _____ **3 cr**
CS 1124, ENGE 2514 (2cr.), CS 2984. If you take 'ENGE 2514' as technical elective, you need to find another one credit hour of tech technical elective to complete 9 credit hours of technical electives.

NOTE: AOE students pursuing a double major will use required courses from their second major to fill the above elective slots.

MATH ELECTIVE: MATH 4574, AOE 4404, OR STAT 4705
(STAT 4705 is required for Ocean Engineering majors) _____ **3 cr**

CORE AND FREE ELECTIVES:

Area 2: _____, _____ **6 cr**

Area 3: (include Econ 2005 or add ISE 2014 as extra requirement) _____, _____ **6 cr**

Area 6: (one credit required, excess credits should be listed as "free" elective) _____ **1 cr**

Area 7 or "Free" Elective _____ **3 cr**
 (This space can be filled with a "free" elective if an Area 7 course was used in Areas 2 or 3)

"Free" Electives _____, _____ **3-5 cr**

(Free electives can include any course taught by the university which does not duplicate required courses or electives or *which is not otherwise defined as not counting for graduation in engineering. See the list of these above.*)

TOTAL ELECTIVES _____
33 cr

Note that "double counting" Area 2 or 3 courses for Area 7 only satisfies the CLE. **You will still need a minimum of 135 (137-140 for DAE, DOE) credit hours to graduate.** You may need to take additional free elective hours. There are no double count courses in Area 6.

Department of Aerospace and Ocean Engineering

College of Engineering

Check sheet for students graduating in calendar year 2016

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	
or AOE	3204	Naval Architecture	3
AOE	4264	Principles of Naval Engineering (NAVE1)	3
AOE	4994	Undergraduate Research	
or xxx	4994	Undergraduate Research with approved NE focus	<u>3</u>
		Total Credits from Required Courses	9
		Credits Remaining from Below	<u>9</u>
		Total Required Credits	18

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

XXX	4xxx	Capstone Design Course with approved NE focus; SE, Team and Project Mgmt components	
XXX	4994	Undergraduate Research w/NE focus (6 w/above)	3
AOE	3204	Naval Architecture	3
AOE	4244	Marine Engineering**	3
AOE	5314	Naval Ship System Design (NAVE2)	3
AOE	3264	Resistance and Propulsion of Ships **	3
AOE	3104	Aircraft Performance**	3
AOE	3134	Stability and Control**	3
AOE	4234	Aerospace Propulsion Systems**	3
AOE	4140	Spacecraft Dynamics and Control**	3
CHE	2164	Chemical Engineering Thermodynamics	3
CHE	3044	Heat Transfer	2
CHE	3184	Chemical Reactor Analysis and Design**	3
CHE	4134	Chemical Process Modeling**	2
CEE	3104	Introduction to Environmental Engineering	3
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.