COLLEGE OF ENGINEERING
DEPARTMENT OF BIOMEDICAL ENGINEERING AND MECHANICS
BACHELOR OF SCIENCE IN ENGINEERING SCIENCE AND MECHANICS
FOR STUDENTS GRADUATING IN CALENDAR YEAR 2018
133 CREDITS REQUIRED FOR GRADUATION

FALL SEMESTER FRESHMAN 2014	Credits	SPRING SEMESTER FRESHMAN 2015	Credits
CHEM 1035 General Chemistry	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	MATH 2114 Introduction to Linear Algebra Pre: MATH 1226 or a grade of at least B in MATH 1225	3
MATH 1225 Calculus of a Single Variable (C-) Pre: Math Ready	4	PHYS 2305 Found of Physics I w/lab Pre: MATH 1225; Co: MATH 1226	4
ENGE 1215 Foundations of Engineering (C-) Co: MATH 1225	2	ENGE 1216 Foundations of Engineering Pre: ENGE 1215 (C-) or ENGE 1024 (C-)	2
CLE (Area 2 or 3)	3		
TOTAL	**16**	**TOTAL**	**16**

FALL SEMESTER SOPHOMORE 2015	Credits	SPRING SEMESTER SOPHOMORE 2016	Credits
CS Programming Course [1] (C)	3	CS 3414 (MATH 3414) Numerical Methods Pre: (CS 1044 (C) or CS 1705 (C) or CS 1114 (C) or CS 1124 (C)), (MATH 2214 or 2214H), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)	3
MATH 2204 Intro Multivariable Calculus Pre: MATH 1226	3	ECE 3054 Electrical Theory Pre: PHYS 2306 Co: MATH 2214	3
MATH 2214 Differential Equations Pre: MATH 1226, MATH 1114 or 2114	3	MSE 2034 Elements of Materials Engr Pre: CHEM 1035 Co: PHYS 2305	3
PHYS 2306 Foundations of Physics I w/lab Pre: MATH 1226, PHYS 2305	4	ESM 2204 Mech of Deformable Bodies Pre: ESM 2104, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)	3
ESM 2014 Prof Development Seminar	1[F]	ESM 2304 Dynamics Pre: ESM 2104, (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)	3
ESM 2104 Statics Co: MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H or MATH 2406H	3	CLE (Areas 2 or 3)	3
TOTAL	**17**	**TOTAL**	**18**

FALL SEMESTER JUNIOR 2016	Credits	SPRING SEMESTER JUNIOR 2017	Credits
ESM 3034 Fluid Mechanics Lab Pre: ESM 2304, ECE 2054 Co: 3234	1[F]	MATH 4574 Vector and Complex Analysis Pre: MATH 2204 or MATH 2224 or MATH 2204H	3
ESM 3054 (MSE 3054) Mech. Behavior of Matrls Pre: ESM 2204, MSE 2034 or MSE 2044 or MSE 3094 or AOE 3094 or CEE 3684	3	ESM 3114 Problem Definition & Scoping in Engineering Design Pre: Junior Standing in ESM, ESM 2014	1[S]
ESM 3064 (MSE 3064) Mech Beh Matrls Lab Pre: ESM 2204; Co: ESM 3054	1	ESM 3134 Dyn III Vib/Controls Pre: ESM 3124, MATH 4564	3[S]
ESM 3124 Dynamics II Pre: ESM 2304, MATH 2214, (MATH 2224 or MATH 2204 or MATH 2204H)	3[F]	ESM 3154 Solid Mechanics Pre: ESM 2204, MATH 2214 Co: MATH 4574	3[S]
ESM 3234 Fluid Mechanics I Pre: ESM 2304, PHYS 2306	3[F]	ESM 3334 Fluid Mechanics II Pre: ESM 3234 Co: MATH 4574	3[S]
MATH 4564 Operational Methods Pre: (MATH 2214 or MATH 2214H) or MATH 2406H or CMDA 2006	3	ESM 3444 Mechanics Lab Pre: ESM 3034, 3054, 3064, 3124, 3234, ECE 3054 Co: ESM 3134, 3154, 3334	2[S]
Science Elective Choose from: BCHM, BIOL, BMVS, CHEM, GEOS, PHYS	3	Technical Elective	3
TOTAL	**17**		**18**

FALL SEMESTER SENIOR 2017	Credits	SPRING SEMESTER SENIOR 2018	Credits
STAT 4604 Statistical Methods for Eng Pre: MATH 1226	3	ESM 4016 Creative Design Pre: ESM 4015	3[S]
ESM 4015 Creative Design Pre: ESM 3114	3[F]	Technical Elective	3
ESM 4734 (AOE 4024) Into to Finite Elements Pre: (CS 3414 or MATH 3414 or AOE 2074), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)	3[F]	Technical Elective	3
Thermodynamics Elective [2]	3	CLE (Areas 2 or 3)	3
Technical Elective	3	CLE (Area 2/3 & 7)	3
		CLE (Area 6)	1
TOTAL	**15**	**TOTAL**	**16**

[1] CS Programming Course chosen from: CS 1044, CS 1064, or CS 1114

[2] Thermodynamics Elective chosen from: BSE 3154, ME 3134, or PHYS 3704

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)		(3)		(3)
CLE Area 4: Scientific Reasoning and Discovery (8 hrs)	PHYS 2305	(4)	PHYS 2306	(4)
CLE Area 5: Quantitative and Symbolic Reasoning (6 hrs)	MATH 1225	(3)	MATH 1226	(3)
CLE Area 6: Creativity & Aesthetic Experience elective (1 hr)				(1)
CLE Area 7: Global Issues Elective (3 hrs)[1]				(3)

[1]A total of 6 hours of Area 2 and 6 hours of Area 3 courses must be completed. Only selected courses can simultaneously satisfy both Area 2/3 & 7 requirements. Use extra care when selecting this course.

Electives:

The ESM degree requires 12 credits of technical electives from list, 3 hours of thermodynamics electives from list, and 3 hours of science electives. Free electives or Area 6 courses offered only on a P/F basis may be taken under the P/F grading option.

Change of Major Requirements: For 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 ESM Department fully supports this policy. Specific expectations for satisfactory progress for Engineering Science and Mechanics majors are as follows:

- Each student must meet the minimum University-wide criteria as described in Policy 91 and summarized in the Undergraduate Catalog (under Academic Policies)
- After having completed 72 credit hours (including transfer, advanced placement, advanced standing, and credit by examination) must have completed ESM 2014, 2104, 2204, 2304, MATH 2214, 2204, and PHYS 2305, 2306
- Maintain an in-major GPA (in-major GPA is calculated using all courses taught under the ESM designator) and an extended in-major GPA (extended in-major GPA is calculated using all ESM courses and MATH 2204, 2214, 4564, and 4574) of 2.0 or better
- Complete a minimum of 12 credits that apply toward the ESM degree per academic year (including summer and winter sessions).

Statement of Hidden Pre-requisites:

- There are no hidden pre-requisites in this program of study.
- Pre-requisites may change from what is indicated. Be sure to consult the University Catalog or check with your advisor for most current requirements.

Graduation Requirements: Each student must complete at least 133 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00.

Approved Technical Electives:
ESM 4014: Applied Fluid Mechanics
ESM 4024: Advanced Mechanical Behavior of Materials
ESM 4044: Mechanics of Composite Materials
ESM 4084 (AOE 4084): Engineering Design Optimization
ESM 4105-4106: Engineering Analysis of Physiologic Systems
ESM 4114: Nonlinear Dynamics and Chaos
ESM 4194 (ME 4194): Sustainable Energy Solutions for a Global Society
ESM 4204: Musculoskeletal Biomechanics
ESM 4224: Biodynamics & Control
ESM 4245-6: Mechanics of Animal Locomotion
ESM 4994: Undergraduate Research
ESM 5014: Introduction to Continuum Mechanics
ESM 5405 or 5406: Clinical Internship in Biomedical Engineering
AOE 3024: Thin-Walled Structures
AOE 3124: Aerospace Structures
AOE 3224: Ocean Structures
AOE 3134: Stability and Control
AOE 4134: Astromechanics
AOE 4214: Ocean Wave Mechanics
CEE 3404: Theory of Structures
CEE 3424: Reinforced Concrete Structures I
CEE 3434: Design of Steel Structures I
ECE 3105-3106: Electromagnetic Fields
ECE 4405-4406: Control Systems
ENGR 3124: Introduction to Green Engineering
ENGR 3134: Environmental Life Cycle Analysis
ME 3304: Heat and Mass Transfer
ME 4224: Aircraft Engines and Gas Turbines
ME 4234: Aerospace Propulsion Systems
ME 4504: Dynamic Systems Controls Engineering I
ME 4524: Introduction to Robotics and Automation
MSE 4055: Materials Selection and Design I
MSE 4164: Principles of Materials Corrosion
MSE 4304: Metals and Alloys
MSE 4574: Biomaterials
MSE 4614: Nanomaterials
CHEM 2535-2536: Organic Chemistry
CHEM 2545-2546: Organic Chemistry Laboratory
MATH 3214: Calculus of Several Variables
MATH 4234: Elementary Complex Analysis
MATH 4445-4446: Introduction to Numerical Analysis
PHYS 3324: Modern Physics
PHYS 3405-3406: Intermediate Electricity and Magnetism
PHYS 4455-4456: Introduction to Quantum Mechanics
PHYS 4504: Introduction to Nuclear and Particle Physics
PHYS 4714: Introduction to Biophysics