COLLEGE OF ENGINEERING
DEPARTMENT OF BIOMEDICAL ENGINEERING AND MECHANICS
DEGREE: BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING
MAJOR: BIOMEDICAL ENGINEERING
FOR STUDENTS ENTERING UNDER UG CATALOG 2021-2022
CREDITS REQUIRED FOR GRADUATION: 123

FALL SEMESTER FIRST YEAR	Credits		SPRING SEMESTER FIRST YEAR	Credits
CHEM 1035 General Chemistry Co: MATH 1025 or MATH 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		MATH 2114[1] Introduction to Linear Algebra Pre: MATH 1225 (B) or MATH 1226	3
MATH 1225 Calculus of a Single Variable (C-) Pre: Math Ready	4		PHYS 2305 Found of Physics I w/lab Pre: (MATH 1205 or MATH 1205H or MATH 1225) or (MATH 1206 or MATH 1206H or MATH 1226). Co: 2325 or (MATH 1206 or MATH 1206H or MATH 1226)	4
ENGE 1215 Foundations of Engineering (C-)	2		ENGE 1216 Foundations of Engineering (C-) Pre: ENGE 1215 (C-)	2
Pathways 2 or 3	3			
TOTAL	**16**		**TOTAL**	**16**

FALL SEMESTER SECOND YEAR	Credits		SPRING SEMESTER SECOND YEAR	Credits
BIOL 1105[1] Principles of Biology	3		BMES 2104[1] Intro to Biomedical Engineering Pre: (ENGE 1216 or ENGE 1414), MATH 2214	3[S]
MATH 2204[1] Intro Multivariable Calculus Pre: MATH 1226	3		ECE 3054[1] Electrical Theory Pre: PHYS 2306 Co: MATH 2214	3
MATH 2214 Intro Differential Equations Pre: MATH 1226, (MATH 1114 or 2114 or MATH 2114H or MATH 2405H)	3		ESM/AOE 2074[1] Computational Methods Pre: ENGE 1114 or ENGE 1216 or ENGE 1434 or ENGE 1414 (C-)	2
ESM 2104[1] Statics Pre: MATH 1226 Co: MATH 2204 or MATH 2204H or MATH 2224 or MATH 2406H	3		ESM 2304[1] Dynamics Co: MATH 2214; Pre: (ESM 2104 or ESM 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)	3
PHYS 2306 Foundations of Physics I w/lab Pre: (MATH 1206 or MATH 1206H or MATH 1226), PHYS 2305	4		MSE 2034[1] Elements of Materials Engr Pre: CHEM 1035 Co: PHYS 2305	3
TOTAL	**16**		**TOTAL**	**14**

FALL SEMESTER THIRD YEAR	Credits		SPRING SEMESTER THIRD YEAR	Credits
BMES 3024[1] BME Cellular Lab and Design Co: 2104, BIOL 1105	2[F]		BMES 3034[1] Bioinstrumentation Laboratory & Design for Living Systems Pre: 2104, ECE 3054	2[S]
ESM 3234[1] Fluid Mechanics I – Control Volume Analysis Pre: ESM 2304, PHYS 2306	3[F]		BMES 3184[1] Problem Solving in BME Pre: 2104	3[S]
ESM 2204[1] Mech of Deformable Bodies Pre: (ESM 2104 or ESM 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)	3		Technical Elective	3
STAT Course*[1]	3		Technical Elective	3
BMES/BMVS 4064 Introduction to Medical Physiology[1] Pre: Junior Standing	3[F]		Pathways 2 or 3	3
TOTAL	**14**			**14**

FALL SEMESTER FOURTH YEAR	Credits		SPRING SEMESTER FOURTH YEAR	Credits
BMES 4015[1] BME Senior Design and Project Pre: 3034, 3184	3[F]		BMES 4016 BME Senior Design and Project Pre: 4015	3[S]
BMES 4134[1] Global, Societal and Ethics in BME Pre: 2104	3[F]		Technical Elective	3
Technical Elective	3		Technical Elective	3
Technical Elective	3		Technical Elective	3
Pathways 2 or 3	3		Pathways 2/7 or 3/7	3
Pathways 6a	3			
TOTAL	**18**		**TOTAL**	**15**

* STAT course chosen from: STAT 3615 Biological Statistics Pre: MATH 1205 or MATH 1525 or MATH 1225 or MATH 1025 or MATH 1524 or ISC 1105
STAT 4604 Statistical Methods for Engineers Pre: MATH 1206 or MATH 1226

General Information about Checksheet: Superscripted annotation after the course number (1) indicates core course of the degree. Additionally, (F, S, SI, SII) in credits column indication 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.

Pathways to General Education (Pathways)
Consult the pathways courses table: https://www.pathways.prov.vt.edu/about/table.html. Pathways courses need to be completed prior to graduation

Pathways Concept 1:	_Foundational:_ **ENGL 1105** (3)	_Foundational:_ **ENGL 1106** (3)
Discourse (6 hrs foundational, 3 hrs advanced)	_Advanced:_ **BMES 4016** (3)	
Pathways Concept 2: Critical Thinking in the Humanities (6 hrs)	(3)	(3)
Pathways Concept 3: Reasoning in the Social Sciences (6 hrs)	(3)	(3)
Pathways Concept 4: Reasoning in the Natural Sciences (8 hrs)	**PHYS 2305** (4)	**PHYS 2306** (4)
Pathways Concept 5: Quantitative and Computational Thinking (11 hrs)	_Foundational:_ **MATH 1225** (4)	_Foundational:_ **MATH 1226** (4)
	Advanced: **MATH 2214** (3)	
Pathways Concept 6: Critique and Practice in Design and the Arts (7 hrs)	_Arts:_ (3)	
	Design: **ENGE 1215 + ENGE 1216** (4)	
Pathways Concept 7: Critical Analysis of Identity & Equity in the US (3 hrs)[1]	Pathways 7 should be double counted with either Pathways 2, 3, or 6a to avoid taking any additional credit hours. (3)	

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

Technical Electives:
The BME degree requires 21 credits of approved technical electives, of which a minimum of 12 credits must be taken from List A. Please see the attached lists for technical elective choices. A 3/4000-level course in another discipline that has significant technical content relevant to the science or application of biomedical engineering can be used as a technical elective only with prior approval.

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 BEAM Department fully supports this policy. Specific expectations for satisfactory progress for Biomedical Engineering 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:
  - Maintain an in-major GPA (in-major GPA is calculated using all courses taught under the BMES designator) and an extended in-major GPA (extended in-major GPA is calculated using all BMES courses and ESM 2104, 2204, and 2304) of 2.0 or better
- Complete a minimum of 12 credits that apply toward the BME degree per academic year (including summer and winter sessions).

Statement of Prerequisites:
- Prerequisites for each course are listed after the course title. The (letter grade) notation, such as (C-), indicates the minimum grade students must earn in the prerequisite course.
- There are no hidden prerequisites in this program of study.
- Prerequisites may change from what is indicated. Be sure to consult the University Catalog or check with your advisor for the most current requirements.

Graduation Requirements: Each student must complete at least 123 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00. All BMES prefix courses count towards the in-major GPA.

Approved Technical Elective Lists for BME Undergraduate Students

Note: Below listed technical elective courses have pre- and/or co-requisites, be sure to consult the University Catalog or check with your advisor. With the exception of courses listed with a credit hour reference in parentheses, technical electives are 3 credit hour courses

List A of Technical Electives (minimum of 12 credits from this list)

BMES 3124 – Introduction to Biomechanics
BMES 3134 – Introduction to BME Imaging
BMES 3144 – Biomedical Devices
BMES 3154 – Bioinstrumentation and Analysis
BMES/ESM 4614 – Probability-based Modeling, Analysis, and Assessment
ESM 4105-4106 – Engineering Analysis of Physiologic Systems
ESM 4204 – Musculoskeletal Biomechanics
ESM 4224 – Biodynamics and Control
ESM 4234 – Mechanics of Biological Materials and Structures
ESM 4245, ESM 4246 – Mechanics of Animal Locomotion
ESM 4304 – Hemodynamics
†BMES/BMVS 5024 – Biomedical Engineering and Human Disease
BMES/BSE/CHE 5044 – Engineering Mathematics
†BMES 5054 – Quantitative Cell Physiology
†BMES 5064 – Quantitative Organ Systems Physiology
†BMES/ESM 5124 – Advanced Musculoskeletal Biomechanics
†BMES 5164 – Advanced Impact Biomechanics
†BMES/ME 5174 – Biomechanics of Crash Injury Prevention
†BMES 5184 – Injury Physiology
†BMES 5204 – Laboratory Techniques in Injury Prevention **(4)**
†BMES/ISE 5214 – Human Physical Capabilities
†BMES 5304G – Advanced Biological Transport Phenomena
†BMES/ESM 5305 – Biomechanics of Cardiovascular System
†BMES/ESM 5306 – Biomechanics of Cardiovascular System
†BMES 5314 – Introduction to Regenerative Medicine
†BMES/CHE 5434 – Polymeric Biomaterials
†BMES 5514/ME 5714 – Digital Signal Processing for Mechanical Measurements
†BMES 5525/ECE 5605 – Stochastic Signals and Systems
†BMES 5534 – Advanced Computational Methods and Modeling for Biomedical Applications
†BMES 5574 – Advanced Biomaterials
†BMES 5614 – Multi-Scale Cancer Engineering
†BMES 5714 – Biomedical Microdevices
†BMES 5724 – Biomedical Nanoengineering
†BMES/ME 5764 – Modeling MEMS and NEMS

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† Students in their senior year, with 3.0 or better GPA, may enroll in 5000-level courses satisfying studendergraduate degree requirements within their department with the permission of the course instructor and the Department Head.

List B of Technical Electives

BCHM 3114 Biochemistry for Biotechnology and the Life Sciences
BMES 4154 Commercialization of BME Research
BMES 5154G Advanced Commercialization of BME Research
BMVS 4054 Laboratory Animal Management
BMVS 4074 Pharmacology
CHEM 2535-CHEM 2536 Organic Chemistry
CHEM 2545-CHEM 2546 Organic Chemistry Lab **(1,1)**
CHEM 4554 Drug Chemistry
ESM/MSE 3054 Mechanical Behavior of Materials
ESM 3124 Dynamics II – Analytical and 3-D Motion
ESM 3334 Fluid Mechanics II: Differential Analysis
ESM 4024 Advanced Mechanical Behavior of Materials
ESM 4044/CEE 4610 Mechanics of Composite Materials
HNFE/PHS 3634 Epidemiologic Concepts of Health and Disease
HNFE 3824 Kinesiology
MATH 3214 Calculus of Several Variables
MATH 4234 Elementary Complex Analysis
MATH 4445,MATH 4446 Introduction to Numerical Analysis
MSE 4164 Principles of Materials Corrosion
MSE 4304 Metals and Alloys
MSE 4574 Biomaterials
MSE 4584 Biomimetic Materials
MSE 4614 Nanomaterials
NEUR 3044 Cellular and Molecular Neuroscience
PHYS 3324 Modern Physics **(4)**
PHYS 3405-PHYS 3406 Intermediate Electricity and Magnetism
PHYS 4455-PHYS 4456 Introduction to Quantum Mechanics
PHYS 4504 Introduction to Nuclear and Particle Physics
PHYS 4574 Nanotechnology
PHYS 4614 Optics
PHYS 4714 Introduction to Biophysics