COMPUTER SCIENCE, BACHELOR OF SCIENCE (B.S.) WITH A CONCENTRATION IN DATA SCIENCE

The Bachelor of Science in Computer Science is built on a rigorous, highly concentrated, accredited curriculum of computer science courses, and includes concentrations in cybersecurity, data science and software engineering. The program provides a strong foundation in the discipline and includes advanced study in several important areas of computer science.

The degree requires a minimum of 120 credit hours and includes undergraduate requirements, general education requirements and computer science major requirements.

Student learning outcomes

Upon completing this program, students will know and know how to do the following:

Computer science core outcomes

- 1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions
- 2. Design, implement and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline
- 3. Communicate effectively in a variety of professional contexts
- Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles
- 5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline
- 6. Apply computer science theory and software development fundamentals to produce computing-based solutions

Data science concentration-specific outcome

1. Apply data science and artificial intelligence algorithms to meet specific data and/or model requirements and produce practical solution to a data analysis or data processing problem

Special requirements

The B.S. in Computer Science with a concentration in data science requires a minimum of 120 credits. Students must receive a minimum grade of C in all computer science courses in order to graduate.

Based on the results of the Computer Science Placement Test, students may be required to take CMSC 254, which then can count toward the degree requirements as an elective.

Degree requirements for Computer Science, Bachelor of Science (B.S.) with a concentration in data science

| Course | Title | Hours |
|----------------------|--|-------|
| General education (h | ttps://bulletin.vcu.edu/undergraduate/ | |
| undergraduate-study | //general-education-curriculum/) | |

Select 30 credits of general education courses in consultation 30 with an adviser. Major requirements Major core requirements **CMSC 235** Computing and Data Ethics 3 **CMSC 254** Introduction to Problem-solving 4 **CMSC 255 Object-oriented Programming** 4 4 **CMSC 256** Introduction to Data Structures **CMSC 302** Introduction to Discrete Structures 3 3 CMSC 303 Introduction to the Theory of Computation **CMSC 304 Programming Languages** 3 3 CMSC 311 **Computer Organization CMSC 355** Fundamentals of Software Engineering 3 4 **CMSC 357 Computer Systems** CMSC 401 Algorithm Analysis with Advanced Data 3 Structures **CMSC 405 Operating Systems** 3 3 **CMSC 408** Databases **CMSC 440** 3 Data Communication and Networking Senior Design Studio I (Laboratory/ CMSC 441 3 & CMSC 451 Project Time) and Senior Project I **CMSC 442** Senior Design Studio II (Laboratory/ 3 & CMSC 452 Project Time) and Senior Project II · Concentration requirements (choose three from the 9 following) **CMSC 435** Introduction to Data Science 3 **CMSC 436** Artificial Intelligence 3 3 **CMSC 437** Introduction to Natural Language Processing **CMSC 438** 3 Machine Learning Ancillary requirements **ECON 205** The Economics of Product 3 Development and Markets (satisfies general education BOK for social/ behavioral science and AOI for global perspectives) **ENGR 395 Professional Development** 1 **MATH 200** Calculus with Analytic Geometry Л I (satisfies general education quantitative foundations) **MATH 201** Calculus with Analytic Geometry II 4 **STAT 212 Concepts of Statistics** 3 6 Humanities electives (from list below) MATH courses (300- to 400-level) 3 Natural science option: Select from BIOL, CHEM or PHYS 4-5 course with a lab (3-5 credits satisfy general education BOK for natural science and AOI for scientific and logical reasoning)¹ **Open electives** Select any course. 9-10 120 **Total Hours**

Select one of the following options:

- Option A: CHEM 101 and CHEZ 101
- Option B: PHYS 207
- Option C: BIOL 151 and BIOZ 151

The minimum number of credit hours required for this degree is 120.

Approved humanities electives

| Сс | ourse Title | Hours |
|----|--|-------|
| Se | elect six credits from the following programs or subject | 6 |
| ar | eas: | |
| | African-American studies | |
| | American studies | |
| | Anthropology | |
| | School of the Arts | |
| | English | |
| | Foreign language | |
| | History | |
| | Philosophy | |
| | Psychology | |

Religious studies Social work Sociology Urban studies

Some courses in other programs (including most honors modules and other courses that focus on human behavior, communication and/ or social interaction) may be counted toward this requirement with departmental approval.

What follows is a sample plan that meets the prescribed requirements within a four-year course of study at VCU. Please contact your adviser before beginning course work toward a degree.

Recommended course sequence/plan of study

Freshman year

| Fall semester | | Hours |
|---|---|-------|
| CMSC 235 | Computing and Data Ethics | 3 |
| CMSC 254 | Introduction to Problem-solving | 4 |
| UNIV 111 Play course video for Introduction to Focused Inquiry: Investigation and Communicati | Introduction to Focused Inquiry: Investigation and Communication (satisfies general education UNIV foundations) on | 3 |
| General educa | ation course | 3 |
| Humanities e | lective (from list) | 3 |
| | Term Hours: | 16 |
| Spring semes | ter | |
| CMSC 255 | Object-oriented Programming | 4 |

| ECON 205 | The Economics of Product Development and Markets (satisfies general education BOK for social/behavioral science and AOI for global perspectives) | 3 |
|---|---|-------|
| MATH 200 | Calculus with Analytic Geometry I (satisfies general education quantitative foundations) | 4 |
| UNIV 112 Play course video for Focused Inquiry II | Focused Inquiry II (satisfies general education UNIV foundations) | 3 |
| | Term Hours: | 14 |
| Sophomore y | rear | |
| Fall semeste | r | |
| CMSC 256 | Introduction to Data Structures | 4 |
| CMSC 302 | Introduction to Discrete Structures | 3 |
| MATH 201 | Calculus with Analytic Geometry II | 4 |
| UNIV 200 | Advanced Focused Inquiry: Literacies, Research and Communication (satisfies general education UNIV foundations) | 3 |
| | Term Hours: | 14 |
| Spring seme | ster | |
| CMSC 304 | Programming Languages | 3 |
| CMSC 311 | Computer Organization | 3 |
| ENGR 395 | Professional Development | 1 |
| STAT 212 | Concepts of Statistics | 3 |
| General educ | ation course | 3 |
| Humanities e | elective (from list) | 3 |
| Junior year Fall semester | | 16 |
| CMSC 303 | Introduction to the Theory of Computation | 3 |
| CMSC 355 | Fundamentals of Software Engineering | 3 |
| CMSC 357 | Computer Systems | 4 |
| education BC | nce option (4-5 credits satisfy general DK for natural science and AOI for scientific easoning)(select one): | 4-5 |
| CHEM 101 & CHEZ 101 | General Chemistry I and General Chemistry Laboratory I | 4 |
| PHYS 207 | University Physics I | 5 |
| BIOL 151 & BIOZ 151 | Introduction to Biological Sciences I and Introduction to Biological Science Laboratory I | 4 |
| General educ | ation course | 3 |
| | Term Hours: | 17-18 |
| Spring seme | ster | |
| CMSC 401 | Algorithm Analysis with Advanced Data Structures | 3 |
| CMSC 405 | Operating Systems | 3 |
| CMSC 408 | Databases | 3 |
| MATH course | e (300- to 400-level) | 3 |
| General educ arts) | ation course (select BOK for humanities/fine | 3 |
| | Term Hours: | 15 |

Senior year

| Tin CMSC 452 Se Concentration red CMSC 437 Int Pr CMSC 438 Ma Open electives | achine Learning | 3 3-7 13 |
|--|---|-----------------------|
| CMSC 442 Set Tin CMSC 452 Set Concentration red CMSC 437 Int Pr CMSC 438 M | rocessing | 3 |
| CMSC 442 Se Tin CMSC 452 Se Concentration red CMSC 437 Int Pr | rocessing | |
| CMSC 442 Se Tin CMSC 452 Se Concentration re CMSC 437 Int | 5 5 | U |
| CMSC 442 Se Tin CMSC 452 Se | troduction to Natural Language | 3 |
| CMSC 442 Se Tii | quirements (select one or two): | 3-6 |
| CMSC 442 Se | enior Project II (capstone) | 1 |
| Spring semester | enior Design Studio II (Laboratory/Project me) | 2 |
| ie | | 15 |
| | erm Hours: | 15 |
| CMSC 436 Ar Open electives | tificial Intelligence | 3 3-6 |
| | troduction to Data Science | 3 |
| | quirements (select one or two): | 3-6 |
| | enior Project I (capstone) | 1 |
| | enior Design Studio I (Laboratory/Project me) | 2 |
| CMSC 440 Da | ata Communication and Networking | 3 |

The minimum number of credit hours required for this degree is 120.

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows gualified students to earn both the B.S.in Computer Science and M.S. in Biomedical Engineering in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students in the program may count up to twelve hours of graduate courses toward both the B.S. and M.S. degrees. Thus, the two degrees may be earned with a minimum of 138 credits rather than the 150 credits necessary if the two degrees are pursued separately.

Students holding these degrees will have a head start for pursuing careers in industry or continuing in academia. The M.S. degree with a thesis option provides formal research experience and both options can lead to expanded job opportunities, greater potential for job advancement and higher starting salaries.

Entrance to the accelerated program

Interested undergraduate students should consult with their adviser as early as possible to receive specific information about the accelerated program, determine academic eligibility and submit (no later than two semesters prior to graduating with a baccalaureate degree, that is, before the end of the spring semester of their junior year) an Accelerated Program Declaration Form to be approved by the graduate program director. Limited spaces may be available in the accelerated program. Academically qualified students may not receive approval if capacity has been reached.

Minimum qualifications for entrance to this accelerated program include an overall GPA of 3.0. Additionally, for students pursuing the thesis option of the master's program, a letter of endorsement from a prospective thesis adviser from the biomedical engineering faculty must accompany the application. Students who are interested in the accelerated program should consult with the faculty adviser to the biomedical engineering

graduate program before they have completed 95 credits. Successful applicants would enter the program in the fall semester of their senior year.

3

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress" section of the Graduate Bulletin, including maintaining a 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate computer science adviser and the faculty adviser to the graduate program.

Admission to the graduate program

Entrance to the accelerated program enables the student to take the approved shared courses that will apply to the undergraduate and graduate degrees. However, entry into an accelerated program via an approved Accelerated Program Declaration Form does not constitute application or admission into the graduate program. Admission to the graduate program requires a separate step that occurs through a formal application to the master's program, which is submitted through Graduate Admissions no later than a semester prior to graduation with the baccalaureate degree, that is, before the end of the fall semester of the senior year. In order to continue pursuing the master's degree after the baccalaureate degree is conferred, accelerated students must follow the admission to graduate study requirements outlined in the VCU Bulletin. Three reference letters (including one from the computer science undergraduate program director and at least one more from a computer science faculty member) must accompany the application. Students who do not meet the minimum GPA requirements may submit GRE scores to receive further consideration.

Degree requirements

The Bachelor of Science in Computer Science degree will be awarded upon completion of a minimum of 120 credits and the satisfactory completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

A maximum of 12 graduate credits of 500-level graduate courses may be taken prior to completion of the baccalaureate degree. These graduate credits will be utilized to fulfill engineering electives course requirements for the undergraduate degree. These courses are shared credits with the graduate program, meaning that they will be applied to both undergraduate and graduate degree requirements.

The graduate courses that may be taken as an undergraduate, once a student is admitted to the program, must be approved by the adviser or graduate program director and include 500-level courses from the following subject areas: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC, INNO and OVPR.

Recommended plan of study for thesis master's

What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the senior year prior to admission to the accelerated program in the senior year.

| Course | Title | Hours |
|---------------|--|-------|
| Senior year | | |
| Fall semester | | |
| CMSC 441 | Senior Design Studio I (Laboratory/ Project Time) | 2 |
| CMSC 451 | Senior Project I | 1 |
| CMSC 440 | Data Communication and Networking | 3 |

| Technical elective (consider BME course pathway) | e for accelerated 6 |
|--|--------------------------------|
| Open electives | 3 |
| Term Hours: | 15 |
| Spring semester | |
| CMSC 442 Senior Design Stu Project Time) | dio II (Laboratory/ 2 |
| CMSC 452 Senior Project II | 1 |
| Technical elective (consider BME course pathway) | e for accelerated 6 |
| Open Elective | 3 |
| Term Hours: | 12 |
| Fifth year | |
| Fall semester | |
| EGRB 601 Numerical Method Biomedical Engine | ds and Modeling in 4 eering |
| EGRB 697 Directed Research Engineering | n in Biomedical 3 |
| Open elective ¹ | 3 |
| Term Hours: | 10 |
| Spring semester | |
| EGRB 602 Biomedical Engine Physiology | eering Systems 4 |
| EGRB 690 Biomedical Engine Seminar | eering Research 1 |
| EGRB 697 Directed Research Engineering | n in Biomedical 4 |
| Term Hours: | 9 |

EGRB, EGMN, ENGR, PHYS, MATH, CMSC, BIOL, PHIS, or BIOC at 500-level or above.

Recommended plan of study for non-thesis master's

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What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the senior year prior to admission to the accelerated program in the senior year.

| Course Senior year | Title | Hours |
|-----------------------------------|---|-------|
| Fall semester | | |
| CMSC 441 | Senior Design Studio I (Laboratory/ Project Time) | 2 |
| CMSC 451 | Senior Project I | 1 |
| CMSC 440 | Data Communication and Networking | 3 |
| Technical electives (pathway) | consider BME course for accelerated | 6 |
| Open elective | | 3 |
| Term Hours: | | 15 |
| Spring semester | | |
| CMSC 442 | Senior Design Studio II (Laboratory/ Project Time) | 2 |
| CMSC 452 | Senior Project II | 1 |

| Technical electives pathway) | s (consider BME course for accelerated | 6 |
|------------------------------|---|----|
| Open Elective | | 3 |
| Term Hours: | | 12 |
| Fifth year | | |
| Fall semester | | |
| EGRB 601 | Numerical Methods and Modeling in Biomedical Engineering | 4 |
| EGRB technical ele | ectives (500-level or above) | 3 |
| Open elective ¹ | | 6 |
| Term Hours: | | 13 |
| Spring semester | | |
| EGRB 602 | Biomedical Engineering Systems Physiology | 4 |
| EGRB 690 | Biomedical Engineering Research Seminar | 1 |
| Open electives | | 6 |
| Term Hours: | | 11 |
| 1 | | |

EGRB, EGMN, ENGR, PHYS, MATH, CMSC, BIOL, PHIS or BIOC at 500-level or above.

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows qualified students to earn both the B.S. and M.S. in Computer Science in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students in the program may count up to six hours of graduate courses toward both the B.S. and M.S. degrees. Thus, the two degrees may be earned with a minimum of 144 credits rather than the 150 credits necessary if the two degrees are pursued separately.

The program is designed to develop skills and educate computer science students to be major contributors in the computing industry. The graduate program in computer science provides state-of-the-art education through the use of didactic courses to those students who wish to further their knowledge and careers within the computing industry. The program emphasizes continuing self-development and broadening of the knowledge of individuals currently engaged in science, technology and engineering-related fields. It also prepares persons who have completed undergraduate majors in these fields for entry into a career in the numerous areas that use computing technology. Both the theoretical and applied aspects of computer science are emphasized in this program.

Entrance to the accelerated program

Interested undergraduate students should consult with their adviser as early as possible to receive specific information about the accelerated program, determine academic eligibility and submit (no later than two semesters prior to graduating with a baccalaureate degree, that is, before the end of the spring semester of their junior year) an Accelerated Program Declaration Form to be approved by the graduate program director. Limited spaces may be available in the accelerated program. Academically qualified students may not receive approval if capacity has been reached.

Minimum qualifications for entrance to this accelerated program include completion of 30 undergraduate credit hours including six computer

science courses CMSC 255, CMSC 256, CMSC 257, CMSC 302, CMSC 303 and CMSC 311; an overall GPA of 3.0; and a GPA of 3.4 in the six courses identified above. Successful applicants would enter the program in the fall semester of their senior year.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress" section of the Graduate Bulletin, including maintaining a 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate computer science adviser and the faculty adviser to the graduate program.

Admission to the graduate program

Entrance to the accelerated program enables the student to take the approved shared courses that will apply to the undergraduate and graduate degrees. However, entry into an accelerated program via an approved Accelerated Program Declaration Form does not constitute application or admission into the graduate program. Admission to the graduate program requires a separate step that occurs through a formal application to the master's program, which is submitted through Graduate Admissions no later than a semester prior to graduation with the baccalaureate degree, that is, before the end of the fall semester of the senior year. In order to continue pursuing the master's degree after the baccalaureate degree is conferred, accelerated students must follow the admission to graduate study requirements outlined in the VCU Bulletin. Three reference letters (including one from the computer science undergraduate program director and at least one more from a computer science faculty member) must accompany the application. Students who do not meet the minimum GPA requirements may submit GRE scores to receive further consideration.

Degree requirements

The Bachelor of Science in Computer Science degree will be awarded upon completion of a minimum of 120 credits and the satisfactory completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

A maximum of 12 graduate credits may be taken prior to completion of the baccalaureate degree. At most, six of these graduate credits will substitute for open elective credits for the undergraduate degree. These courses are shared credits with the graduate program, meaning that they will be applied to both undergraduate and graduate degree requirements.

The graduate computer science courses that may be taken as an undergraduate, once a student is admitted to the program, are:

| Course | Title | Hours |
|--------------------|--|-------|
| Maximum for shared | l credits is 12. | |
| CMSC 501 | Advanced Algorithms | 3 |
| CMSC 502 | Parallel Algorithms | 3 |
| CMSC 510 | Regularization Methods for Machine Learning | 3 |
| CMSC 516 | Advanced Natural Language Processing | 3 |
| CMSC 525 | Introduction to Software Analysis, Testing and Verification | 3 |
| CMSC 591 | Topics in Computer Science | 3 |

Recommended course sequence/plan of study for students pursuing a thesis master's

What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the junior year prior to admission to the accelerated program in the senior year.

| 0 | Title | |
|-------------------------------|---|-------|
| Course Junior year | litle | Hours |
| Fall semester | | |
| CMSC 257 | Computer Systems | 4 |
| CMSC 303 | Introduction to the Theory of | - |
| CIW3C 303 | Computation | 5 |
| CMSC 355 | Fundamentals of Software Engineering | 3 |
| | ence course (BIOL, CHEM or PHYS ward the major in that science) | 4-5 |
| Select one of the follo | owing: | |
| BIOL 151 & BIOZ 151 | Introduction to Biological Sciences I and Introduction to Biological Science Laboratory I | |
| CHEM 101 & CHEZ 101 | General Chemistry I and General Chemistry Laboratory I | |
| PHYS 207 | University Physics I | |
| General education co | | 3 |
| Contact undergradua | te and graduate program directors | |
| Term Hours: | | 17-18 |
| Spring semester | | |
| CMSC 401 | Algorithm Analysis with Advanced Data Structures | 3 |
| CMSC 408 | Databases | 3 |
| CMSC 440 | Data Communication and Networking | 3 |
| MATH upper-level (30 | 00 to 400) | 3 |
| General education co arts) | urse (select BOK for humanities/fine | 3 |
| Secure approval from | undergraduate program director | |
| Apply to the M.S. pro | gram | |
| Term Hours: | | 15 |
| Senior year | | |
| Fall semester | | |
| CMSC 441 | Senior Design Studio I (Laboratory/ Project Time) | 2 |
| CMSC 451 | Senior Project I | 1 |
| CMSC 501 | Advanced Algorithms | 3 |
| CMSC 516 | Advanced Natural Language Processing | 3 |
| Open electives | | 6 |
| Term Hours: | | 15 |
| Spring semester | | |
| CMSC 312 | Introduction to Operating Systems | 3 |
| CMSC 442 | Senior Design Studio II (Laboratory/ Project Time) | 2 |
| CMSC 452 | Senior Project II | 1 |
| CMSC 525 | Introduction to Software Analysis, Testing and Verification (counts toward B.S. and M.S.) | 3 |

| CMSC 5XX (Select fo above.) | urth shared graduate course from list | 3 |
|-----------------------------|---------------------------------------|----|
| Choose the M.S. thes | is adviser | |
| Term Hours: | | 12 |
| Fifth year | | |
| Fall semester | | |
| CMSC 697 | Directed Research | 3 |
| M.S. foundational are | ea courses (theory and systems) 1 | 6 |
| Term Hours: | | 9 |
| Spring semester | | |
| CMSC 697 | Directed Research | 6 |
| M.S. foundational are | ea course (applied) ¹ | 3 |
| Term Hours: | | 9 |

See the Graduate Bulletin for the list of theory, systems and applied foundational area courses.

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Recommended course sequence/plan of study for students pursuing a non-thesis master's

What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the junior year prior to admission to the accelerated program in the senior year.

| Junior yearFall semesterCMSC 257Computer Systems4CMSC 303Introduction to the Theory of Computation3CMSC 355Fundamentals of Software Engineering3Approved natural science course (BIOL, CHEM or PHYS course that counts toward the major in that science)4-5Select one of the following:8BIOL 151Introduction to Biological Sciences I Laboratory I4CHEM 101General Chemistry I ad General Chemistry Laboratory I4CHEX 101and General Chemistry Laboratory I7PHYS 207University Physics I3General education course33Contact undergraduate and graduate program directors3Term Hours:17-18Spring semester3CMSC 400Data communication and Networking3CMSC 440Data Communication and Networking3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director3Apply to the M.S. program4 | Course | Title | Hours |
|--|----------------------|--|-------|
| CMSC 257Computer Systems4CMSC 303Introduction to the Theory of Computation3CMSC 355Fundamentals of Software Engineering3Approved natural science course (BIOL, CHEM or PHYS course that counts toward the major in that science)4-5Select one of the following:8BIOL 151Introduction to Biological Sciences I Laboratory ICHEM 101General Chemistry I & CHEZ 101& CHEZ 101and General Chemistry Laboratory IPHYS 207University Physics IGeneral education course3Contact undergraduate and graduate program directors3Term Hours:17-18Spring semester3CMSC 400Data Communication and Networking3General education course (select BOK for humanities/fine arts)3General education course (select BOK for humanities/fine arts)3 | Junior year | | |
| CMSC 303Introduction to the Theory of Computation3 ComputationCMSC 355Fundamentals of Software Engineering3Approved natural science course (BIOL, CHEM or PHYS course that counts toward the major in that science)4-5Select one of the following:8BIOL 151Introduction to Biological Sciences I Laboratory I& BIOZ 151and Introduction to Biological Science Laboratory ICHEM 101General Chemistry I & CHEZ 101& CHEZ 101and General Chemistry Laboratory IPHYS 207University Physics IGeneral education course3Contact undergraduate and graduate program directorsTerm Hours:17-18Spring semester17-18CMSC 401Algorithm Analysis with Advanced Data StructuresCMSC 440Data Communication and Networking 3MATH upper-level (300 to 400)3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director | | 0 | |
| ComputationCMSC 355Fundamentals of Software Engineering3Approved natural science course (BIOL, CHEM or PHYS course that counts toward the major in that science)4-5Select one of the following:8BIOL 151Introduction to Biological Sciences I Laboratory I4CHEM 101General Chemistry I & CHEZ 1014Contact undergraduate and graduate program directors3Contact undergraduate and graduate program directors3Consc 401Algorithm Analysis with Advanced Data Structures3CMSC 408Databases3CMSC 440Data Communication and Networking3MATH upper-level (300 to 400)33General education course153Secure approval from the undergraduate program director3 | | | |
| Approved natural science course (BIOL, CHEM or PHYS course that counts toward the major in that science)4-5Select one of the following:BIOL 151 and Introduction to Biological Sciences I Laboratory I4-5CHEM 101 & CHEZ 101 CHEZ 101General Chemistry I and General Chemistry Laboratory I4-5PHYS 207 PHYS 207 Contact undergraduate and graduate program directors3Contact undergraduate and graduate program directors17-18Spring semester CMSC 401 Algorithm Analysis with Advanced Data Structures3CMSC 408 Databases3CMSC 440Data Communication and Networking3MATH upper-level (300 to 400)33General education course153Secure approval from the undergraduate program director15 | CMSC 303 | | 3 |
| course that counts toward the major in that science) Select one of the following: BIOL 151 Introduction to Biological Sciences I & BIOZ 151 and Introduction to Biological Science Laboratory I CHEM 101 General Chemistry I & CHEZ 101 and General Chemistry Laboratory I PHYS 207 University Physics I General education course 3 Contact undergraduate and graduate program directors Term Hours: 17-18 Spring semester CMSC 401 Algorithm Analysis with Advanced Data 3 Structures CMSC 440 Data Communication and Networking 3 MATH upper-level (300 to 400) 3 General education course (select BOK for humanities/fine arts) Term Hours: 15 Secure approval from the undergraduate program director | CMSC 355 | Fundamentals of Software Engineering | 3 |
| BIOL 151Introduction to Biological Sciences I & BIOZ 151& BIOZ 151and Introduction to Biological Science Laboratory ICHEM 101General Chemistry I & CHEZ 101& CHEZ 101and General Chemistry Laboratory IPHYS 207University Physics IGeneral education course3Contact undergraduate and graduate program directorsTerm Hours:17-18Spring semester17-18CMSC 401Algorithm Analysis with Advanced Data StructuresCMSC 408DatabasesCMSC 440Data Communication and NetworkingMATH upper-level (300 to 400)3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director15 | | | 4-5 |
| & BIOZ 151and Introduction to Biological Science Laboratory ICHEM 101General Chemistry I & CHEZ 101& CHEZ 101and General Chemistry Laboratory IPHYS 207University Physics IGeneral education course3Contact undergraduate and graduate program directors17-18Spring semester17-18CMSC 401Algorithm Analysis with Advanced Data Structures3CMSC 408Databases3CMSC 440Data Communication and Networking3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director15 | Select one of the fo | llowing: | |
| & CHEZ 101and General Chemistry Laboratory IPHYS 207University Physics IGeneral education course3Contact undergraduate and graduate program directors3Contact undergraduate and graduate program directors17-18Spring semester17-18CMSC 401Algorithm Analysis with Advanced Data StructuresCMSC 408DatabasesCMSC 440Data Communication and NetworkingMATH upper-level (300 to 400)3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director | | and Introduction to Biological Science | |
| General education course3Contact undergraduate and graduate program directorsTerm Hours:17-18Spring semester17-18CMSC 401Algorithm Analysis with Advanced Data Structures3CMSC 408Databases3CMSC 440Data Communication and Networking3MATH upper-level (300 to 400)3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director | | - | |
| Contact undergraduate and graduate program directorsTerm Hours:17-18Spring semesterCMSC 401CMSC 401Algorithm Analysis with Advanced Data StructuresCMSC 408DatabasesCMSC 440Data Communication and Networking3MATH upper-level (300 to 400)3General education course (select BOK for humanities/fine arts)Term Hours:15Secure approval from the undergraduate program director | PHYS 207 | University Physics I | |
| Term Hours:17-18Spring semesterCMSC 401Algorithm Analysis with Advanced Data Structures3CMSC 408Databases3CMSC 440Data Communication and Networking3MATH upper-level (300 to 400)3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director | General education of | course | 3 |
| Spring semester Algorithm Analysis with Advanced Data Structures 3 CMSC 401 Algorithm Analysis with Advanced Data Structures 3 CMSC 408 Databases 3 CMSC 440 Data Communication and Networking 3 MATH upper-level (300 to 400) 3 General education course (select BOK for humanities/fine arts) 3 Term Hours: 15 Secure approval from the undergraduate program director 15 | Contact undergradu | ate and graduate program directors | |
| CMSC 401Algorithm Analysis with Advanced Data Structures3CMSC 408Databases3CMSC 440Data Communication and Networking3MATH upper-level (300 to 400)3General education course (select BOK for humanities/fine arts)3Term Hours:15Secure approval from the undergraduate program director | Term Hours: | | 17-18 |
| Structures 3 CMSC 408 Databases 3 CMSC 440 Data Communication and Networking 3 MATH upper-level (300 to 400) 3 General education course (select BOK for humanities/fine arts) 3 Term Hours: 15 Secure approval from the undergraduate program director | Spring semester | | |
| CMSC 440 Data Communication and Networking 3 MATH upper-level (300 to 400) 3 General education course (select BOK for humanities/fine arts) 3 Term Hours: 15 Secure approval from the undergraduate program director | CMSC 401 | · · | 3 |
| MATH upper-level (300 to 400) 3 General education course (select BOK for humanities/fine arts) 3 Term Hours: 15 Secure approval from the undergraduate program director | CMSC 408 | Databases | 3 |
| General education course (select BOK for humanities/fine 3 arts) 3 Term Hours: 15 Secure approval from the undergraduate program director | CMSC 440 | Data Communication and Networking | 3 |
| arts) Term Hours: 15 Secure approval from the undergraduate program director | MATH upper-level (3 | 300 to 400) | 3 |
| Secure approval from the undergraduate program director | | course (select BOK for humanities/fine | 3 |
| | Term Hours: | | 15 |
| Apply to the M.S. program | Secure approval fro | m the undergraduate program director | |
| 11.5 | Apply to the M.S. pr | ogram | |

| Senior year | | |
|--------------------------|---|----|
| Fall semester | | |
| CMSC 441 | Senior Design Studio I (Laboratory/ Project Time) | 2 |
| CMSC 451 | Senior Project I | 1 |
| CMSC 501 | Advanced Algorithms | 3 |
| CMSC 516 | Advanced Natural Language Processing | 3 |
| Open electives | | 6 |
| Term Hours: | | 15 |
| Spring semester | | |
| CMSC 312 | Introduction to Operating Systems | 3 |
| CMSC 442 | Senior Design Studio II (Laboratory/ Project Time) | 2 |
| CMSC 452 | Senior Project II | 1 |
| CMSC 525 | Introduction to Software Analysis, Testing and Verification (counts toward B.S. and M.S.) | 3 |
| CMSC 5XX (Select above.) | fourth shared graduate course from list | 3 |
| Term Hours: | | 12 |
| Fifth year | | |
| Fall semester | | |
| M.S. foundational | area courses (theory, systems and applied) | 9 |
| Term Hours: | | 9 |
| Spring semester | | |
| Graduate didactic | course work | 9 |
| Term Hours: | | 9 |
| 1 | | |

See the Graduate Bulletin for the list of theory, systems and applied foundational area courses.

Accelerated B.S. and M.S.

The accelerated B.S.-to-M.S. program allows qualified students to earn both the B.S. in Computer Science and the M.S. in Engineering, concentration in aerospace engineering; chemical and life science engineering; electrical and computer engineering; engineering management; environmental and sustainable engineering; rehabilitation engineering; systems engineering; or tissue engineering and regenerative medicine in a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students in the program may count up to six hours (non-thesis option) or 12 hours (thesis option) of graduate courses toward both the B.S. and M.S. degrees.

Students holding these degrees will have a head start for pursuing careers in industry or continuing in academia. The M.S. degree provides formal research experience and can lead to expanded job opportunities, greater potential for job advancement and higher starting salaries.

Entrance to the accelerated program

Interested undergraduate students should consult with their adviser as early as possible to receive specific information about the accelerated program, determine academic eligibility and submit (no later than two semesters prior to graduating with a baccalaureate degree, that is, before the end of the spring semester of their junior year) an Accelerated Program Declaration Form to be approved by the graduate program director. Limited spaces may be available in the accelerated program. Academically qualified students may not receive approval if capacity has been reached.

Minimum qualifications for entrance to any accelerated program include completion of 95 undergraduate credit hours and a minimum overall GPA of 3.0. Students who are interested in the accelerated program should consult with the faculty adviser to the graduate program before they have completed 95 credits. Successful applicants would enter the program in the following semester after graduation with the bachelor's degree.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress (https://bulletin.vcu.edu/ academic-regs/grad/satisfactory-academic-progress/)" section of the Graduate Bulletin, including maintaining a 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate graduate program adviser and the graduate program director.

Admission to the graduate program

Entrance to the accelerated program enables the student to take the approved shared courses that will apply to the undergraduate and graduate degrees. However, entry into an accelerated program via an approved Accelerated Program Declaration Form does not constitute application or admission into the graduate program. Admission to the graduate program requires a separate step that occurs through a formal application to the master's program, which is submitted through Graduate Admissions no later than a semester prior to graduation with the baccalaureate degree, that is before the end of the fall semester of the senior year. In order to continue pursuing the master's degree after the baccalaureate degree is conferred, accelerated students must follow the admission to graduate study requirements outlined in the VCU Bulletin. The GRE and application fee is waived for admission to the program for all students. Additionally, for students pursuing the thesis option of the master's program, a letter of endorsement from a prospective thesis adviser from a faculty member in the relevant department may accompany the application.

Degree requirements

The Bachelor of Science in Computer Science degree will be awarded upon completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

For students entering the non-thesis option, a maximum of six graduate credits may be taken prior to the completion of the baccalaureate degree. For students entering the thesis option, a maximum of 12 graduate credits may be taken. These graduate credits will count as open or technical elective credits for the undergraduate degree. These courses are shared credits with the graduate program, meaning that they will be applied to both undergraduate and graduate degree requirements.

The graduate courses that may be taken as an undergraduate, once a student is admitted to the program, must be approved by the adviser or graduate program director and include 500-level courses from the following subject areas: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC, INNO and OVPR.

Curriculum requirements

Concentration in aerospace engineering

| | in aerospace engineering | |
|---|--|-------|
| Thesis option Course | Title | Hours |
| | e-level coursework | nours |
| Engineering or oth a minimum of 9 cr in EGRE, ENGR, EC advisory committe | er relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ee: This component allows the student to ther engineering or science with approval of | 12 |
| Concentration cor | nponent | |
| EGMN 604 | Mechanical and Nuclear Engineering Materials | 3 |
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | 3 |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | 3 |
| EGMN 607 | Heat and Mass Transfer Theory and Applications | 3 |
| Directed research | component | |
| • | mphasizes research directed toward ree requirements under the direction of an ory committee. | |
| EGMN 697 | Directed Research in Mechanical and Nuclear Engineering | 6 |
| Total Hours | | 30 |
| Non-thesis option | | |
| Course | Title | Hours |
| Required graduate | e-level coursework | |
| a minimum of 9 cr in EGRE, ENGR, EC adviser. This comp in either engineeri adviser. | er relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ponent allows the student to take courses ng or science with approval of the student's | 15 |
| Concentration con | | |
| EGMN 604 | Mechanical and Nuclear Engineering Materials | 3 |
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | 3 |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | 3 |
| EGMN 607 | Heat and Mass Transfer Theory and Applications | 3 |
| EGMN 661 | Computational Fluid Dynamics | 3 |
| Total Hours | | 30 |

Concentration in chemical and life science engineering

| Thesis option | | |
|--|--|--------------------------------------|
| Course | Title | Hours |
| Required graduate-le | evel coursework | |
| a minimum of 6 cred in EGRE, ENGR, EGR by the advisory com | relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved mittee: This component allows the ses in either engineering or science with ent's adviser. | 9 |
| Concentration comp | onent - CLSE course work | |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | 3 |
| CLSE 654 | Equilibrium Analysis in Chemical and Biological Systems | 3 |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | 3 |
| CLSE 656 | Advanced Chemical Reaction Engineering | 3 |
| Choose additional C | LSE course work at the 500 level or higher | 3 |
| Directed research | | |
| Select six credit hou | rs from the following: | 6 |
| CLSE 690 | Research Seminar in Chemical and Life Science Engineering | |
| CLSE 697 | Directed Research in Chemical and Life Science Engineering | |
| | oololloo Eligilloolling | |
| Total Hours | | 30 |
| Non-thesis option | | |
| Non-thesis option Course | Title | 30 Hours |
| Non-thesis option Course Required graduate-le | Title evel coursework | Hours |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of | Title | |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of courses in either eng student's adviser. | Title evel coursework relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved component allows the student to take | Hours |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of courses in either end student's adviser. Concentration comp | Title evel coursework relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved component allows the student to take gineering or science with approval of the | Hours |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of courses in either end student's adviser. Concentration comp | Title evel coursework relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved component allows the student to take gineering or science with approval of the onent - CLSE course work Quantitative Analysis in Chemical and | Hours 12 |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of courses in either eng student's adviser. Concentration comp CLSE 650 | Title evel coursework relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved component allows the student to take gineering or science with approval of the onent - CLSE course work Quantitative Analysis in Chemical and Life Science Engineering Equilibrium Analysis in Chemical and | Hours 12 3 |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of courses in either end student's adviser. Concentration comp CLSE 650 CLSE 654 | Title evel coursework relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved component allows the student to take gineering or science with approval of the onent - CLSE course work Quantitative Analysis in Chemical and Life Science Engineering Equilibrium Analysis in Chemical and Biological Systems Nonequilibrium Analysis in Chemical | Hours 12 3 3 |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of courses in either end student's adviser. Concentration comp CLSE 650 CLSE 655 CLSE 655 CLSE 656 | Title evel coursework relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved component allows the student to take gineering or science with approval of the onent - CLSE course work Quantitative Analysis in Chemical and Life Science Engineering Equilibrium Analysis in Chemical and Biological Systems Nonequilibrium Analysis in Chemical and Life Science Engineering Advanced Chemical Reaction | Hours 12 3 3 3 |
| Non-thesis option Course Required graduate-le Engineering or other a minimum of 9 cred in EGRE, ENGR, EGR by the adviser. This of courses in either end student's adviser. Concentration comp CLSE 650 CLSE 655 CLSE 655 CLSE 656 | Title evel coursework relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE, PESC) approved component allows the student to take gineering or science with approval of the orent - CLSE course work Quantitative Analysis in Chemical and Life Science Engineering Equilibrium Analysis in Chemical and Biological Systems Nonequilibrium Analysis in Chemical and Life Science Engineering Advanced Chemical Reaction Engineering | Hours 12 3 3 3 3 3 |

| Course | Title | Hours |
|--------------------|--|-------|
| Required graduat | e-level coursework | |
| Engineering or otl | her relevant graduate course work (including | 12 |
| a minimum of 9 c | redit hours from 500-level or higher courses | |
| in EGRE, ENGR, E | GRB, EGMN, CMSC, CLSE) approved by the | |
| advisory committ | ee: This component allows the student to | |

| Course Required graduate-le Engineering or other a minimum of 9 credi in EGRE, ENGR, EGRE adviser. This compor | relevant graduate course work (including it hours from 500-level or higher courses 3, EGMN, CMSC, CLSE) approved by the nent allows the student to take courses or science with approval of the student's | 30 Hours 18 3 3 3 3 |
|---|--|---------------------------------------|
| Total Hours Concentration in Course Required graduate-le Engineering or other a minimum of 9 credi in EGRE, ENGR, EGRE adviser. This compor in either engineering adviser. Concentration compor EGMN 507 ENGR 601 | Title vel coursework relevant graduate course work (including it hours from 500-level or higher courses B, EGMN, CMSC, CLSE) approved by the nent allows the student to take courses or science with approval of the student's onent Law and Engineering Engineering Project Management | Hours 18 3 3 |
| Total Hours Concentration in Course Required graduate-le Engineering or other a minimum of 9 credi in EGRE, ENGR, EGRE adviser. This compor in either engineering adviser. Concentration compo | Title evel coursework relevant graduate course work (including it hours from 500-level or higher courses 8, EGMN, CMSC, CLSE) approved by the nent allows the student to take courses or science with approval of the student's onent | Hours 18 |
| Total Hours Concentration in Course Required graduate-le Engineering or other a minimum of 9 credi in EGRE, ENGR, EGRE adviser. This compor- in either engineering adviser. | Title evel coursework relevant graduate course work (including it hours from 500-level or higher courses 8, EGMN, CMSC, CLSE) approved by the nent allows the student to take courses or science with approval of the student's onent | Hours |
| Total Hours Concentration in Course Required graduate-le Engineering or other a minimum of 9 credi in EGRE, ENGR, EGRE adviser. This compor in either engineering | Title evel coursework relevant graduate course work (including it hours from 500-level or higher courses 8, EGMN, CMSC, CLSE) approved by the tent allows the student to take courses | Hours |
| Total Hours Concentration in Course Required graduate-le | Title vel coursework | Hours |
| Total Hours Concentration in Course | Title | |
| Total Hours | engineering management | 30 |
| Total Hours | | 30 |
| discipline. | | |
| EGRE course work (E approved by the advis to pursue a series of | GRE 500-level or higher or courses ser): This component allows the student courses that focus on a specific field of e as the student's primary engineering | 15 |
| Concentration compo | onent | |
| Engineering or other a minimum of 9 credi in EGRE, ENGR, EGRE adviser. This compon | relevant graduate course work (including it hours from 500-level or higher courses 3, EGMN, CMSC, CLSE) approved by the tent allows the student to take courses or science with approval of the student's | 15 |
| Course Required graduate-le | | nours |
| Total Hours Non-thesis option | Title | 30 Hours |
| | Computer Engineering | 20 |
| adviser and advisory EGRE 697 | Directed Research in Electrical and | 6 |
| completion of degree | hasizes research directed toward requirements under the direction of an | |
| primary engineering | | |
| , | GRE 500-level or higher or courses sory committee): This component pursue a series of courses that focus | 12 |
| EGRE course work (E | | |
| | | |

Concentration in environmental and sustainable engineering

| Thesis | option |
|--------|--------|
| Course | • |

| adviser. Concentration comp CLSE 545 CLSE 580 CLSE 650 CLSE 655 Total Hours | Water Essentials Sustainable Chemical Engineering Quantitative Analysis in Chemical and Life Science Engineering Nonequilibrium Analysis in Chemical and Life Science Engineering rehabilitation engineering Title | 3 3 3 3 30 Hours |
|--|--|---------------------------------|
| adviser. Concentration comp CLSE 545 CLSE 580 CLSE 650 CLSE 655 Total Hours Concentration in Thesis option | Water Essentials Sustainable Chemical Engineering Quantitative Analysis in Chemical and Life Science Engineering Nonequilibrium Analysis in Chemical and Life Science Engineering | 3 3 3 30 |
| adviser. Concentration comp CLSE 545 CLSE 580 CLSE 650 CLSE 655 Total Hours Concentration in | Water Essentials Sustainable Chemical Engineering Quantitative Analysis in Chemical and Life Science Engineering Nonequilibrium Analysis in Chemical and Life Science Engineering | 3 3 3 |
| adviser. Concentration comp CLSE 545 CLSE 580 CLSE 650 CLSE 655 | Water Essentials Sustainable Chemical Engineering Quantitative Analysis in Chemical and Life Science Engineering Nonequilibrium Analysis in Chemical | 3 3 3 |
| adviser. Concentration comp CLSE 545 CLSE 580 CLSE 650 | Water Essentials Sustainable Chemical Engineering Quantitative Analysis in Chemical and Life Science Engineering Nonequilibrium Analysis in Chemical | 3 3 |
| adviser. Concentration comp CLSE 545 CLSE 580 | Water Essentials Sustainable Chemical Engineering Quantitative Analysis in Chemical and | 3 |
| adviser. Concentration comp CLSE 545 CLSE 580 | Water Essentials Sustainable Chemical Engineering | 3 |
| adviser. Concentration comp CLSE 545 | Water Essentials | |
| adviser. Concentration comp | | 2 |
| adviser. | | |
| | or science with approval of the student's | |
| a minimum of 9 cred in EGRE, ENGR, EGR adviser: This compo | relevant graduate course work (including lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE) approved by the nent allows the student to take courses | 18 |
| Required graduate-le | | |
| Non-thesis option Course | Title | Hours |
| Total Hours | | 30 |
| CLSE 697 | Directed Research in Chemical and Life Science Engineering | 6 |
| completion of degree adviser and advisory | phasizes research directed toward e requirements under the direction of an v committee. | |
| Directed research co | omponent | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | 3 |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | 3 |
| CLSE 580 | Sustainable Chemical Engineering | 3 |
| CLSE 545 | Water Essentials | 3 |
| the student's adviser | | |
| advisory committee: take courses in eithe | lit hours from 500-level or higher courses B, EGMN, CMSC, CLSE) approved by the This component allows the student to er engineering or science with approval of | |
| | relevant graduate course work (including | 12 |
| a minimum of 9 cred | | |
| a minimum of 9 cred | evel coursework | |

| Engineering or other relevant graduate course work (including |
|--|
| a minimum of 6 credit hours from 500-level or higher courses |
| in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the |
| advisory committee: This component allows the student to |
| take courses in either engineering or science with approval of |
| the student's adviser. |
| Concentration component |

Assistive Technology

EGRB 520

| EGRB 521 | | |
|---|--|--|
| | Human Factors Engineering | 3 |
| EGRB 523 | Rehabilitation Engineering and Prostheses | 3 |
| EGRB 603 | Biomedical Signal Processing | 3 |
| ANAT 610 | Systems Neuroscience | 4 |
| Directed researc | h | |
| EGRB 697 | Directed Research in Biomedical Engineering | 6 |
| Total Hours | | 30 |
| Non-thesis optio Course | n Title | Hours |
| | ite-level coursework | Hours |
| | ther relevant graduate course work (including | 14 |
| a minimum of 9 in EGRE, ENGR, adviser. This cor | credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the nponent allows the student to take courses ring or science with approval of the student's | 14 |
| Concentration c | omponent | |
| EGRB 520 | Assistive Technology | 3 |
| EGRB 521 | Human Factors Engineering | 3 |
| EGRB 523 | Rehabilitation Engineering and Prostheses | 3 |
| | | 0 |
| EGRB 603 | Biomedical Signal Processing | 3 |
| EGRB 603 ANAT 610 Total Hours | Systems Neuroscience | 3 4 30 |
| ANAT 610 Total Hours Concentratio Thesis option | Systems Neuroscience | 4 30 |
| ANAT 610 Total Hours Concentratio Thesis option Course | Systems Neuroscience on in systems engineering Title | 4 |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua | Systems Neuroscience on in systems engineering Title te-level coursework | 4 30 Hours |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, advisory commi | Systems Neuroscience Systems engineering Title T | 4 30 |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, advisory commitake courses in o | Systems Neuroscience Systems engineering Title Ite-level coursework ther relevant graduate course work (including credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the ttee: This component allows the student to either engineering or science with approval of viser. | 4 30 Hours |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, advisory commi take courses in o the student's ad | Systems Neuroscience Systems engineering Title Ite-level coursework ther relevant graduate course work (including credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the ttee: This component allows the student to either engineering or science with approval of viser. | 4 30 Hours 12 |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, advisory commi take courses in o the student's ad Concentration c EGRE 510 | Systems Neuroscience Title Title tte-level coursework ther relevant graduate course work (including credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the ttee: This component allows the student to either engineering or science with approval of viser. pomponent | 4 30 Hours 12 3 |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, advisory commi take courses in o the student's ad Concentration c | Systems Neuroscience Systems engineering Title Title Te-level coursework Ther relevant graduate course work (including credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the ttee: This component allows the student to either engineering or science with approval of viser. Tomponent Introduction to Internet of Things | 4 30 Hours |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, advisory commitake courses in of take courses in of the student's ad Concentration cont EGRE 510 EGRE 512 EGRE 513 | Systems Neuroscience Systems Neuroscience Systems engineering Title Title Te-level coursework Ther relevant graduate course work (including credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the ttee: This component allows the student to either engineering or science with approval of viser. Tomponent Introduction to Internet of Things Intelligent Autonomous Systems Fundamentals of Modern Systems | 4 30 Hours 12 3 3 3 |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, advisory commitake courses in of the student's ad Concentration co EGRE 510 EGRE 512 EGRE 513 EGRE 615 | Systems Neuroscience Systems Neuroscience Systems engineering Title Title Te-level coursework Ther relevant graduate course work (including credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the ttee: This component allows the student to either engineering or science with approval of viser. Dimponent Introduction to Internet of Things Intelligent Autonomous Systems Engineering Systems Modeling | 4 30 Hours 12 3 3 3 3 |
| ANAT 610 Total Hours Concentratio Thesis option Course Required gradua Engineering or o a minimum of 9 in EGRE, ENGR, i advisory commitate courses in o the student's ad Concentration co EGRE 510 EGRE 512 EGRE 512 EGRE 513 EGRE 615 Directed researco This component completion of de | Systems Neuroscience Systems Neuroscience Systems engineering Title Title Te-level coursework Ther relevant graduate course work (including credit hours from 500-level or higher courses EGRB, EGMN, CMSC, CLSE) approved by the ttee: This component allows the student to either engineering or science with approval of viser. Dimponent Introduction to Internet of Things Intelligent Autonomous Systems Engineering Systems Modeling | 4 30 Hours 12 3 3 3 3 |

8

| Course | Title | Hours |
|--|---|----------------|
| Required graduat | e-level coursework | |
| a minimum of 9 c in EGRE, ENGR, E adviser: This com | her relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ponent allows the student to take courses ing or science with approval of the student's | 18 |
| Concentration co | mponent | |
| EGRE 510 | Introduction to Internet of Things | 3 |
| EGRE 512 | Intelligent Autonomous Systems | 3 |
| EGRE 513 | Fundamentals of Modern Systems Engineering | 3 |
| EGRE 615 | Systems Modeling | 3 |
| Total Hours | | 30 |
| Concentration medicine Thesis option Course | n in tissue engineering and regenerat | LIVE Hours |
| | e-level coursework | |
| a minimum of 9 c | her relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the | 12 |
| - | ee: This component allows the student to the rengineering or science with approval of | |
| take courses in ei the student's adv | ee: This component allows the student to the rengineering or science with approval of | |
| take courses in ei the student's adv | ee: This component allows the student to ther engineering or science with approval of iser. | ; |
| take courses in ei the student's adv Concentration co | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work | |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 | tee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine | : |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials | : |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering | : |
| take courses in ei the student's adv Concentration co EGRB 512 | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering | : |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical | : |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering | 3 |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 Total Hours Non-thesis option Course | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering | 3 Hours |
| take courses in eithe student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 Total Hours Non-thesis option Course Required graduat Engineering or otl a minimum of 9 c in EGRE, ENGR, E adviser: This com in either engineer | tee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering Title | 3 |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 Total Hours Non-thesis option Course Required graduat Engineering or ot a minimum of 9 c in EGRE, ENGR, E adviser: This com in either engineer adviser. | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering Title e-level coursework her relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ponent allows the student to take courses | 3 Hour |
| take courses in eithe student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 Total Hours Non-thesis option Course Required graduat Engineering or otl a minimum of 9 c in EGRE, ENGR, E adviser: This com in either engineer adviser. Concentration co | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering Title e-level course work her relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ponent allows the student to take courses ing or science with approval of the student's | 3 Hour |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 Total Hours Non-thesis option Course Required graduat Engineering or ot a minimum of 9 c in EGRE, ENGR, E adviser. This com in either engineer adviser. Concentration co EGRB 512 | ree: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering Title e-level coursework her relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ponent allows the student to take courses ing or science with approval of the student's mponent - TERM course work | 3 Hour 1 |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 Total Hours Non-thesis option Course Required graduat Engineering or ot a minimum of 9 c in EGRE, ENGR, E adviser: This com in either engineer adviser. Concentration co EGRB 512 EGRB 613 | ree: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering Title e-level coursework her relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ponent allows the student to take courses ing or science with approval of the student's mponent - TERM course work Regenerative Engineering and Medicine | 3 Hour 1 |
| take courses in ei the student's adv Concentration co EGRB 512 EGRB 613 EGRB 614 EGRB 616 Directed research EGRB 697 Total Hours Non-thesis option Course Required graduat Engineering or ot a minimum of 9 c in EGRE, ENGR, E adviser: This com in either engineer adviser. | ee: This component allows the student to ther engineering or science with approval of iser. mponent - TERM course work Regenerative Engineering and Medicine Biomaterials Tissue Engineering Cell Engineering Directed Research in Biomedical Engineering Title e-level course work her relevant graduate course work (including redit hours from 500-level or higher courses GRB, EGMN, CMSC, CLSE) approved by the ponent allows the student to take courses ing or science with approval of the student's mponent - TERM course work Regenerative Engineering and Medicine Biomaterials | 3 Hour 1 |

Recommended course sequence/plan of study What follows is the recommended plan of study for students interested in the accelerated program beginning in the fall of the junior/senior year prior to admission to the accelerated program in the senior year.

| Course | Title | Hours |
|----------------------|---|-------|
| Junior year | | |
| Fall semester | | |
| CMSC 257 | Computer Systems | 4 |
| CMSC 303 | Introduction to the Theory of Computation | 3 |
| CMSC 355 | Fundamentals of Software Engineering | 3 |
| | ence course (BIOL, CHEM or PHS course he major in that science) | 4-5 |
| | following (BIOL 151 and CHEM 101 I laboratory course listed below) | |
| BIOL 151 | Introduction to Biological Sciences I | |
| BIOZ 151 | Introduction to Biological Science Laboratory I | |
| CHEM 101 | General Chemistry I | |
| CHEZ 101 | General Chemistry Laboratory I | |
| PHYS 207 | University Physics I | |
| General education co | ourse | 3 |
| Contact undergradua | ate and graduate program directors | |
| Term Hours: | | 17-18 |
| Spring semester | | |
| CMSC 312 | Introduction to Operating Systems | 3 |
| CMSC 401 | Algorithm Analysis with Advanced Data Structures | 3 |
| CMSC 408 | Databases | 3 |
| MATH upper-level (3 | 00-400) | 3 |
| | ence course (BIOL, CHEM or PHS course he major in that science) | 4-5 |
| | following (BIOL 152 and CHEM 102 I laboratory course listed below) | |
| BIOL 152 | Introduction to Biological Sciences II | |
| BIOZ 152 | Introduction to Biological Science Laboratory II | |
| CHEM 102 | General Chemistry II | |
| CHEZ 102 | General Chemistry Laboratory II | |
| PHYS 208 | University Physics II | |
| Term Hours: | , , | 16-17 |
| Senior year | | |
| Fall semester | | |
| CMSC 440 | Data Communication and Networking | 3 |
| CMSC 441 | Senior Design Studio I (Laboratory/ Project Time) | 2 |
| CMSC 451 | Senior Project I | 1 |

| Technical elective (consider appropriate MS program course for accelerated pathway) | | | |
|---|---|----|--|
| Open electives | | 3 | |
| Term Hours: | | 12 | |
| Spring semester | | | |
| CMSC 442 | Senior Design Studio II (Laboratory/ Project Time) | 2 | |
| CMSC 452 | Senior Project II | 1 | |
| Technical elective (consider appropriate MS program course for accelerated pathway) | | | |
| Open Elective | | 3 | |
| Term Hours: | | 12 | |
| | | | |

EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC and OVPR at 500-level or above

Concentration in aerospace engineering

| Course | Title | Hours |
|-------------------|--|-------|
| Fifth year | | |
| Thesis option | | |
| Fall semester | | |
| Required graduate | -level courses ¹ | 3 |
| Concentration spe | cific courses | 6 |
| EGMN 604 | Mechanical and Nuclear Engineering Materials | |
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | |
| EGMN 607 | Heat and Mass Transfer Theory and Applications | |
| Directed research | 2 | 3 |
| EGMN 697 | Directed Research in Mechanical and Nuclear Engineering | |
| Term Hours: | | 12 |
| Spring semester | | |
| Required graduate | -level courses ¹ | 3 |
| Concentration spe | cific courses | 6 |
| EGMN 604 | Mechanical and Nuclear Engineering Materials | |
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | |
| EGMN 607 | Heat and Mass Transfer Theory and Applications | |
| Directed research | 2 | 3 |
| EGMN 697 | Directed Research in Mechanical and Nuclear Engineering | |
| Term Hours: | | 12 |
| Non-thesis option | | |
| Fall semester | | |
| Required graduate | -level courses ¹ | 3 |
| Concentration spe | cific courses | 6 |

| EGMN 604 | Mechanical and Nuclear Engineering Materials | |
|----------------------|---|---|
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | |
| EGMN 607 | Heat and Mass Transfer Theory and Applications | |
| EGMN 661 | Computational Fluid Dynamics | |
| Term Hours: | | 9 |
| Spring semester | | |
| Required graduate-le | vel courses ¹ | 3 |
| Concentration specif | ic courses | 6 |
| EGMN 604 | Mechanical and Nuclear Engineering Materials | |
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | |
| EGMN 607 | Heat and Mass Transfer Theory and Applications | |
| EGMN 661 | Computational Fluid Dynamics | |
| Term Hours: | | 9 |
| 1 | | |

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the student to take courses in either engineering or science with approval of the student's adviser.

2

This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.

Concentration in chemical and life science engineering

| Course | Title | Hours |
|--------------------------------|---|-------|
| Fifth year | | |
| Thesis option | | |
| Fall semester | | |
| Required graduate-le | vel courses ¹ | 3 |
| Concentration specif | ic courses | 6 |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
| CLSE 654 | Equilibrium Analysis in Chemical and Biological Systems | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| CLSE 656 | Advanced Chemical Reaction Engineering | |
| Directed research ² | | 3 |
| CLSE 690 | Research Seminar in Chemical and Life Science Engineering | |

1

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3

| CLSE 697 | Directed Research in Chemical and Life Science Engineering | |
|--------------------------------|---|----|
| Term Hours: | | 12 |
| Spring semester | | |
| Required graduate- | level courses ¹ | 3 |
| Concentration spec | cific courses | 6 |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
| CLSE 654 | Equilibrium Analysis in Chemical and Biological Systems | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| CLSE 656 | Advanced Chemical Reaction Engineering | |
| Choose addition higher | al CLSE course work at the 500 level or | |
| Directed research ² | | 3 |
| CLSE 690 | Research Seminar in Chemical and Life Science Engineering | |
| CLSE 697 | Directed Research in Chemical and Life Science Engineering | |
| Term Hours: | | 12 |
| Non-thesis option | | |
| Fall semester | | |
| Required graduate- | level courses ¹ | 3 |
| Concentration spec | cific courses | 6 |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
| CLSE 654 | Equilibrium Analysis in Chemical and Biological Systems | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| CLSE 656 | Advanced Chemical Reaction Engineering | |
| Term Hours: | | 9 |
| Spring semester | | |
| Required graduate- | level courses ¹ | 3 |
| Concentration spec | | 6 |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
| CLSE 654 | Equilibrium Analysis in Chemical and Biological Systems | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| CLSE 656 | Advanced Chemical Reaction Engineering | |
| Term Hours: | | 9 |
| 1 | | |
| | | |

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the student to take courses in either engineering or science with approval of the student's adviser.

This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.

Concentration in electrical and computer engineering

| Course | Title | Hours |
|-------------------|---|-------|
| Fifth year | | |
| Thesis option | | |
| Fall semester | | |
| Required graduat | e-level courses ¹ | 3 |
| Concentration sp | ecifc courses ² | 6 |
| Directed research | 3 | 3 |
| EGRE 697 | Directed Research in Electrical and Computer Engineering | |
| Term Hours: | | 12 |
| Spring semester | | |
| Required graduat | | 3 |
| Concentration sp | | 6 |
| Directed research | 3 | 3 |
| EGRE 697 | Directed Research in Electrical and Computer Engineering | |
| Term Hours: | | 12 |
| Non-thesis option | n | |
| Fall semester | | |
| Required graduat | | 3 |
| Concentration sp | ecific courses ² | 6 |
| Term Hours: | | 9 |
| Spring semester | | |
| Required graduat | e-level courses | 3 |
| Concentration sp | ecific courses ² | 6 |
| Term Hours: | | 9 |

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the student to take courses in either engineering or science with approval of the student's adviser.

EGRE course work (EGRE 500-level or higher or courses approved by the advisory committee): This component allows the student to pursue a series of courses that focus on a specific field of engineering and serve as the student's primary engineering discipline.

mponent emphasi

This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.

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|----------------|------|-----------|-----|------------|
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| CONCENTRATION | | CIIGIICCI | шy | management |

| Course | Title | Hours |
|---------------------------------|---|-------|
| Fifth year | | |
| Fall semester | | |
| Required graduate- | level courses ¹ | 3 |
| Concentration spec | cifc courses | 6 |
| EGMN 507 | Law and Engineering | |
| ENGR 601 | Engineering Project Management | |
| ENGR 602 | Engineering Contracts and Effective Negotiations | |
| ENGR 696 | Engineering Products and Economic Considerations | |
| Term Hours: | | 9 |
| Spring semester | | |
| Required graduate-level courses | | |
| Concentration spec | cific courses | 6 |
| EGMN 507 | Law and Engineering | |
| ENGR 601 | Engineering Project Management | |
| ENGR 602 | Engineering Contracts and Effective Negotiations | |
| ENGR 696 | Engineering Products and Economic Considerations | |
| 1 | | |

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the student to take courses in either engineering or science with approval of the student's adviser.

Concentration in environmental and sustainable engineering

| Course | Title | Hours |
|--------------------------------|---|-------|
| Fifth year | | |
| Thesis option | | |
| Fall semester | | |
| Required graduate-le | evel courses ¹ | 3 |
| Concentration speci | fic | 6 |
| CLSE 545 | Water Essentials | |
| CLSE 580 | Sustainable Chemical Engineering | |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| Directed research ² | | 3 |
| CLSE 697 | Directed Research in Chemical and Life Science Engineering | |
| Term Hours: | | 12 |
| Spring semester | | |
| Required graduate-le | 3 | |
| Concentration speci | 6 | |
| CLSE 545 | Water Essentials | |
| CLSE 580 | Sustainable Chemical Engineering | |

| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
|--------------------------------|---|----|
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| Directed research ² | | 3 |
| CLSE 697 | Directed Research in Chemical and Life Science Engineering | |
| Term Hours: | | 12 |
| Non-thesis option | | |
| Fall semester | | |
| Required graduate-le | evel courses ¹ | 3 |
| Concentration specif | îc courses | 6 |
| CLSE 545 | Water Essentials | |
| CLSE 580 | Sustainable Chemical Engineering | |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| Term Hours: | | 9 |
| Spring semester | | |
| Required graduate-le | evel courses ¹ | 3 |
| Concentration specif | îc courses | 6 |
| CLSE 545 | Water Essentials | |
| CLSE 580 | Sustainable Chemical Engineering | |
| CLSE 650 | Quantitative Analysis in Chemical and Life Science Engineering | |
| CLSE 655 | Nonequilibrium Analysis in Chemical and Life Science Engineering | |
| Term Hours | | 9 |
| 1 | | |

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the student to take courses in either engineering or science with approval of the student's adviser.

2

This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.

Concentration in rehabilitation engineering

| Course | Title | Hours |
|-----------------------|--|-------|
| Fifth year | | |
| Thesis option | | |
| Fall semester | | |
| Required graduate-lev | vel courses ¹ | 3 |
| Concentration specifo | courses | 6 |
| EGRB 520 | Assistive Technology | |
| EGRB 521 | Human Factors Engineering | |
| EGRB 523 | Rehabilitation Engineering and Prostheses | |
| EGRB 603 | Biomedical Signal Processing | |
| ANAT 610 | Systems Neuroscience | |

| Directed research | 2 | 3 |
|--|--|----|
| EGRB 697 | Directed Research in Biomedical Engineering | |
| Term Hours: | 5 5 | 12 |
| Spring semester | | |
| Required graduate | -level courses ¹ | 3 |
| Concentration spe | | 6 |
| EGRB 520 | Assistive Technology | |
| EGRB 521 | Human Factors Engineering | |
| EGRB 523 | Rehabilitation Engineering and Prostheses | |
| EGRB 603 | Biomedical Signal Processing | |
| ANAT 610 | Systems Neuroscience | |
| Directed research | 2 | 3 |
| EGRB 697 | Directed Research in Biomedical Engineering | |
| Term Hours: | | 12 |
| Non-thesis option | | |
| Fall semester | | |
| Required graduate | -level courses ¹ | 3 |
| Concentration spe | cific courses | 6 |
| EGRB 520 | Assistive Technology | |
| EGRB 521 | Human Factors Engineering | |
| EGRB 523 | Rehabilitation Engineering and Prostheses | |
| EGRB 603 | Biomedical Signal Processing | |
| ANAT 610 | Systems Neuroscience | |
| Term Hours: | | 9 |
| Spring semester | | |
| Required graduate-level courses ¹ | | 3 |
| Concentration spe | cific courses | 6 |
| EGRB 520 | Assistive Technology | |
| EGRB 521 | Human Factors Engineering | |
| EGRB 523 | Rehabilitation Engineering and Prostheses | |
| | 11000100000 | |
| EGRB 603 | Biomedical Signal Processing | |
| EGRB 603 ANAT 610 | | |

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the student to take courses in either engineering or science with approval of the student's adviser.

2

This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.

Concentration in systems engineering

| ooncentration | in systems engineering | |
|--------------------------------|---|-------|
| Course Fifth year | Title | Hours |
| Thesis option | | |
| Fall semester | | |
| Required graduate- | lovel courses ¹ | 3 |
| Concentration spec | | 6 |
| | | 0 |
| EGRE 510 | Introduction to Internet of Things | |
| EGRE 512 | Intelligent Autonomous Systems | |
| EGRE 513 | Fundamentals of Modern Systems Engineering | |
| EGRE 615 | Systems Modeling | |
| Directed research | | 3 |
| EGRE 697 | Directed Research in Electrical and Computer Engineering | |
| Term Hours: | | 12 |
| Spring semester | | |
| Required graduate- | level courses ¹ | 3 |
| Concentration spec | | 6 |
| EGRE 510 | Introduction to Internet of Things | |
| EGRE 512 | Intelligent Autonomous Systems | |
| EGRE 513 | Fundamentals of Modern Systems Engineering | |
| EGRE 615 | Systems Modeling | |
| Directed research ² | | 3 |
| EGRE 697 | Directed Research in Electrical and Computer Engineering | |
| Term Hours: | | 12 |
| Non-thesis option | | . – |
| Fall semester | | |
| Required graduate- | level courses ¹ | 3 |
| Concentration spec | | 6 |
| EGRE 510 | Introduction to Internet of Things | 0 |
| EGRE 512 | - | |
| | Intelligent Autonomous Systems | |
| EGRE 513 | Fundamentals of Modern Systems Engineering | |
| EGRE 615 | Systems Modeling | |
| Term Hours: | | 9 |
| Spring semester | | |
| Required graduate- | level courses | 3 |
| Concentration spec | cific courses | 6 |
| EGRE 510 | Introduction to Internet of Things | |
| EGRE 512 | Intelligent Autonomous Systems | |
| EGRE 513 | Fundamentals of Modern Systems Engineering | |
| EGRE 615 | Systems Modeling | |
| Term Hours | | 9 |
| 1 | | |

1

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the

student to take courses in either engineering or science with approval of the student's adviser.

2

This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.

Concentration in tissue engineering and regenerative medicine

| Course | Title | Hours |
|--------------------------------|--|-------|
| Fifth year | | |
| Thesis option | | |
| Fall semester | | |
| Required graduate-le | vel courses ¹ | 3 |
| Concentration specif | | 6 |
| EGRB 512 | Regenerative Engineering and Medicine | |
| EGRB 613 | Biomaterials | |
| EGRB 614 | Tissue Engineering | |
| EGRB 616 | Cell Engineering | |
| Directed research ² | | 3 |
| EGRB 697 | Directed Research in Biomedical Engineering | |
| Term Hours: | | 12 |
| Spring semester | | |
| Required graduate-le | vel courses ¹ | 3 |
| Concentration specif | ic courses | 6 |
| EGRB 512 | Regenerative Engineering and Medicine | |
| EGRB 613 | Biomaterials | |
| EGRB 614 | Tissue Engineering | |
| EGRB 616 | Cell Engineering | |
| Directed research ² | | 3 |
| EGRB 697 | Directed Research in Biomedical Engineering | |
| Term Hours: | | 12 |
| Non-thesis option | | |
| Fall semester | | |
| Required graduate-le | vel courses | 3 |
| Concentration specif | ic courses | 6 |
| EGRB 512 | Regenerative Engineering and Medicine | |
| EGRB 613 | Biomaterials | |
| EGRB 614 | Tissue Engineering | |
| EGRB 616 | Cell Engineering | |
| Term Hours: | | 9 |
| Required graduate-le | vel courses | |
| Concentration specif | ic courses | |
| EGRB 512 | Regenerative Engineering and Medicine | |
| EGRB 613 | Biomaterials | |
| EGRB 614 | Tissue Engineering | |
| EGRB 616 | Cell Engineering | |
| Term Hours: | | 9 |

Engineering or other relevant graduate course work (including a minimum of 9 credit hours from 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE) approved by the adviser. This component allows the student to take courses in either engineering or science with approval of the student's adviser.

2

This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.

Accelerated B.S. and M.S.

The accelerated B.S. and M.S. program allows qualified students to earn both the B.S.in Computer Science and M.S. in Mechanical and Nuclear Engineering a minimum of five years by completing approved graduate courses during the senior year of their undergraduate program. Students in the program may count up to twelve hours of graduate courses toward both the B.S. and M.S. degrees. Thus, the two degrees may be earned with a minimum of 138 credits rather than the 150 credits necessary if the two degrees are pursued separately.

The program is designed to develop skills and educate computer science students to be major contributors in the computing industry. The graduate program in computer science provides state-of-the-art education through the use of didactic courses to those students who wish to further their knowledge and careers within the computing industry. The program emphasizes continuing self-development and broadening of the knowledge of individuals currently engaged in science, technology and engineering-related fields. It also prepares persons who have completed undergraduate majors in these fields for entry into a career in the numerous areas that use computing technology. Both the theoretical and applied aspects of computer science are emphasized in this program.

Entrance to the accelerated program

Interested undergraduate students should consult with their adviser as early as possible to receive specific information about the accelerated program, determine academic eligibility and submit (no later than two semesters prior to graduating with a baccalaureate degree, that is, before the end of the spring semester of their junior year) an Accelerated Program Declaration Form to be approved by the graduate program director. Limited spaces may be available in the accelerated program. Academically qualified students may not receive approval if capacity has been reached.

Minimum qualifications for entrance to this accelerated program include an overall GPA of 3.0. Additionally, for students pursuing the thesis option of the master's program, a letter of endorsement from a prospective thesis adviser from the biomedical engineering faculty must accompany the application. Students who are interested in the accelerated program should consult with the faculty adviser to the mechanical and nuclear engineering graduate program before they have completed 95 credits. Successful applicants would enter the program in the fall semester of their senior year.

Once enrolled in the accelerated program, students must meet the standards of performance applicable to graduate students as described in the "Satisfactory academic progress" section of the Graduate Bulletin, including maintaining a 3.0 GPA. Guidance to students admitted to the accelerated program is provided by both the undergraduate computer science adviser and the faculty adviser to the graduate program.

Admission to the graduate program

Entrance to the accelerated program enables the student to take the approved shared courses that will apply to the undergraduate and graduate degrees. However, entry into an accelerated program via an approved Accelerated Program Declaration Form does not constitute application or admission into the graduate program. Admission to the graduate program requires a separate step that occurs through a formal application to the master's program, which is submitted through Graduate Admissions no later than a semester prior to graduation with the baccalaureate degree, that is, before the end of the fall semester of the senior year. In order to continue pursuing the master's degree after the baccalaureate degree is conferred, accelerated students must follow the admission to graduate study requirements outlined in the VCU Bulletin. Three reference letters (including one from the computer science undergraduate program director and at least one more from a computer science faculty member) must accompany the application. Students who do not meet the minimum GPA requirements may submit GRE scores to receive further consideration.

Degree requirements

The Bachelor of Science in Computer Science degree will be awarded upon completion of a minimum of 120 credits and the satisfactory completion of all undergraduate degree requirements as stated in the Undergraduate Bulletin.

A maximum of 12 graduate credits of 500-level graduate courses may be taken prior to completion of the baccalaureate degree. These graduate credits will be utilized to fulfill engineering electives course requirements for the undergraduate degree. These courses are shared credits with the graduate program, meaning that they will be applied to both undergraduate and graduate degree requirements.

The graduate courses that may be taken as an undergraduate, once a student is admitted to the program, must be approved by the adviser or graduate program director and include 500-level courses from the following subject areas: EGMN, EGRM, ENGR, EGRN, EGRB, EGRE, CLSE, CMSC, PHYS, MATH, NANO, CHEM, BIOL, GRAD, LFSC, INNO and OVPR.

Recommended course sequence/plan of study

What follows is the recommended plan of graduate study for students interested in the accelerated program beginning in the fall of the senior year.

For students pursuing the thesis option

| Course | Title | Hours |
|------------------------------------|---|-------|
| Senior year | | |
| Fall semester | | |
| CMSC 441 | Senior Design Studio I (Laboratory/ Project Time) | 2 |
| CMSC 451 | Senior Project I | 1 |
| CMSC 440 | Data Communication and Networking | 3 |
| Technical elective (co pathway) | onsider MNE course for accelerated | 3 |
| Open electives | | 6 |
| Term Hours: | | 15 |
| Spring semester | | |
| CMSC 442 | Senior Design Studio II (Laboratory/ Project Time) | 2 |

| CMSC 452 | Senior Project II | 1 |
|---|--|----|
| Technical electives pathway) | consider MNE course for accelerated | 6 |
| Open Elective | | 3 |
| Term Hours: | | 12 |
| Fifth year | | |
| Fall semester | | |
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | 3 |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | 3 |
| EGMN 610 | Topics in Nuclear Engineering | 3 |
| Term Hours: | | 9 |
| Spring semester | | |
| EGMN 697 | Directed Research in Mechanical and Nuclear Engineering | 6 |
| Technical electives (Select 600-level courses with permission of graduate program director) | | 3 |
| Term Hours: | | 9 |

For students pursuing the non-thesis option

| Course | Title | Hours |
|--|---|-------|
| Senior year | | |
| Fall semester | | |
| CMSC 441 | Senior Design Studio I (Laboratory/ Project Time) | 2 |
| CMSC 451 | Senior Project I | 1 |
| CMSC 440 | Data Communication and Networking | 3 |
| Technical electives pathway) | s (consider MNE course for accelerated | 3 |
| Open electives | | 6 |
| Term Hours: | | 15 |
| Spring semester | | |
| CMSC 442 | Senior Design Studio II (Laboratory/ Project Time) | 2 |
| CMSC 452 | Senior Project II | 1 |
| Technical electives pathway) | s (consider MNE course for accelerated | 6 |
| Open Elective | | 3 |
| Term Hours: | | 12 |
| Fifth year | | |
| Fall semester | | |
| EGMN 605 | Mechanical and Nuclear Engineering Analysis | 3 |
| EGMN 606 | Mechanical and Nuclear Engineering Continuum Mechanics | 3 |
| EGMN 610 | Topics in Nuclear Engineering | 3 |
| Term Hours: | | 9 |
| Spring semester | | |
| Technical electives of graduate progra | s (Select 600-level courses with permission m director) | 6 |
| | s (Select 500- or 600-level courses with luate program director) | 3 |
| Term Hours: | | 9 |
| | | |