

# BACHELOR OF ARTS (BA) DEGREE WITH A MAJOR IN COMPUTATIONAL AND APPLIED MATHEMATICS

## BA Degree with a Major in Computational and Applied Mathematics

Upon completing the BA degree with a major in Computational and Applied Mathematics, students will be able to:

1. Apply fundamental mathematics to perform critical analysis of an abstracted version of a real world problem and to build a model that captures the problem's salient characteristics.
2. Design, implement, and debug a computer program to solve a computational problem.
3. Critically analyze a mathematical or computational problem, explore techniques to model and solve the problem, and use mathematical or computational methods to produce one or more solutions.
4. Interpret a model and its results and communicate the results effectively to non-experts both orally and in writing.

## Requirements for the BA Degree with a Major in Computational and Applied Mathematics

For general university requirements, see [Graduation Requirements \(https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/\)](https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/). Students pursuing the BA degree with a major in Computational and Applied Mathematics must complete:

- A minimum of 17-18 courses (49-52 credit hours), depending on course selection, to satisfy major requirements.
- A minimum of 120 credit hours to satisfy degree requirements.
- A minimum of 13 courses (37 credit hours) taken at the 300-level or above.

The courses listed below satisfy the requirements for this major. In certain instances, courses not on this official list may be substituted upon approval of the major's academic advisor, or where applicable, the department's Director of Undergraduate Studies. (Course substitutions must be formally applied and entered into Degree Works by the major's [Official Certifier \(https://registrar.rice.edu/facstaff/degreeworks/officialcertifier/\)](https://registrar.rice.edu/facstaff/degreeworks/officialcertifier/).) Students and their academic advisors should identify and clearly document the courses to be taken.

### Summary

Code	Title	Credit Hours
Total Credit Hours Required for the Major in Computational and Applied Mathematics		49-52
Total Credit Hours Required for the BA Degree with a Major in Computational and Applied Mathematics		120

## Degree Requirements

Code	Title	Credit Hours
<b>Core Requirements</b>		
Introductory Courses <sup>1</sup>		
CAAM 210	INTRODUCTION TO ENGINEERING COMPUTATION	3
CAAM 335 or CAAM 334	MATRIX ANALYSIS <sup>2</sup> MATRIX ANALYSIS FOR DATA SCIENCE	3
MATH 101 or MATH 105	SINGLE VARIABLE CALCULUS I <sup>3</sup> AP/OTH CREDIT IN CALCULUS I	3
MATH 102 or MATH 106	SINGLE VARIABLE CALCULUS II AP/OTH CREDIT IN CALCULUS II	3
<i>Select 1 from the following:</i>		3-6
MATH 212	MULTIVARIABLE CALCULUS	
MATH 221 & MATH 222	HONORS CALCULUS III and HONORS CALCULUS IV	
Intermediate Courses <sup>4</sup>		
CAAM 336	DIFFERENTIAL EQUATIONS IN SCIENCE AND ENGINEERING	3
CAAM 378	INTRODUCTION TO OPERATIONS RESEARCH AND OPTIMIZATION	3
MATH 302 or MATH 321 or MATH 322 or MATH 331	ELEMENTS OF ANALYSIS <sup>5</sup> INTRODUCTION TO ANALYSIS I INTRODUCTION TO ANALYSIS II HONORS ANALYSIS	3
STAT 310 / ECON 307 or STAT 418	PROBABILITY AND STATISTICS PROBABILITY	3
Advanced Courses <sup>6</sup>		
CAAM 453	NUMERICAL ANALYSIS I	3
CAAM 454 or CAAM 471	ITERATIVE METHODS FOR SYSTEMS OF EQUATIONS AND UNCONSTRAINED OPTIMIZATION LINEAR AND INTEGER PROGRAMMING	3
Design Project <sup>7</sup>		
CAAM 495	SENIOR DESIGN PROJECT I	2
CAAM 496	SENIOR DESIGN PROJECT II	2
<b>Elective Requirements <sup>8</sup></b>		
<i>Select 2 elective courses at the 300-level or above</i>		6
<i>Select 2 elective courses at the 400-level or above</i>		6
<b>Total Credit Hours Required for the Major in Computational and Applied Mathematics</b>		<b>49-52</b>
Additional Credit Hours to Complete Degree Requirements		37-40
University Graduation Requirements ( <a href="https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/">https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/</a> ) <sup>*</sup>		31
<b>Total Credit Hours</b>		<b>120</b>

## Footnotes and Additional Information

\* **Note:** [University Graduation Requirements](#) include 31 credit hours, comprised of Distribution Requirements (Groups I, II, and III), FWIS, and LPAP coursework. In some instances, courses satisfying FWIS or distribution requirements may additionally meet other requirements, such as the Analyzing Diversity (AD) requirement, or some of the student's declared major, minor, or certificate requirements. [Additional Credit Hours to Complete Degree Requirements](#) include general electives, coursework completed as upper-level, residency (hours taken at Rice), and/or any other additional academic program requirements.

1 The Introductory Courses requirement is typically fulfilled during the student's first two years.

2 Students may petition the Director of Undergraduate Studies to substitute MATH 354 for CAAM 335.

3 Students with prior experience with calculus may replace MATH 101 or MATH 105 with a 3-credit quantitative elective at the 200-level or above, as approved by a CMOR undergraduate advisor (this quantitative elective is in addition to the four electives required below). Entering students should enroll in the most advanced course commensurate with their background; advice is available from the CMOR department during Orientation Week.

4 The Intermediate Courses requirement is typically fulfilled by the end of the student's third year.

5 Students who plan to pursue graduate studies in Computational and Applied Mathematics should take MATH 302 *and* MATH 321.

6 The Advanced Courses requirement is typically completed by the end of the student's fourth year.

7 The Design Project requirement is typically fulfilled during the student's fourth year.

8 To fulfill the remaining Computational and Applied Mathematics major requirements, students must complete 4 additional courses (12 credit hours) at the 300-level or above.

At least 2 elective courses (6 credit hours) must be from the departmental (CAAM) course offerings and may not include CAAM 480, CAAM 497 or independent study courses (such as CAAM 490 or CAAM 491). Elective courses from other programs must be chosen from a list approved by the CAAM Undergraduate Committee. At least 2 elective courses (6 credit hours) must be at the 400-level or above. The elective courses completed must be taken for a minimum of 3 credit hours. Highly recommended electives may be found in the Highly Recommended Electives list (below).

## Highly Recommended Electives

Code	Title	Credit Hours
CAAM 415 / ELEC 488 / NEUR 415	THEORETICAL NEUROSCIENCE: FROM CELLS TO LEARNING SYSTEMS	3
CAAM 419	COMPUTATIONAL SCIENCE I	3
CAAM 423 / MATH 423	PARTIAL DIFFERENTIAL EQUATIONS I	3
CAAM 435 / MATH 435	DYNAMICAL SYSTEMS	3
CAAM 436	MODELING MATHEMATICAL PHYSICS	3
CAAM 452 / CEVE 455	NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS	3

CAAM 454	ITERATIVE METHODS FOR SYSTEMS OF EQUATIONS AND UNCONSTRAINED OPTIMIZATION	3
or CAAM 471	LINEAR AND INTEGER PROGRAMMING	
CAAM 470	GRAPH THEORY	3
CAAM 551	NUMERICAL LINEAR ALGEBRA	3
CAAM 552	FOUNDATIONS OF FINITE ELEMENT METHODS	3
CAAM 560	OPTIMIZATION THEORY	3
CAAM 564	NUMERICAL OPTIMIZATION	3
CAAM 565	CONVEX OPTIMIZATION	3
CAAM 574	COMBINATORIAL OPTIMIZATION	3
MATH 322	INTRODUCTION TO ANALYSIS II	3
MATH 425	INTEGRATION THEORY	3
MATH 427	COMPLEX ANALYSIS	3

## Policies for the BA Degree with a Major in Computational and Applied Mathematics

### Program Restrictions and Exclusions

Students pursuing the BA degree with a major in Computational and Applied Mathematics should be aware of the following program restrictions:

- As noted in [Majors, Minors, and Certificates \(https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/\)](https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/), students may not major and minor in the same subject.
- Students pursuing the major in Computational and Applied Mathematics may not additionally declare the major in Operations Research.

### Transfer Credit

For Rice University's policy regarding transfer credit, see [Transfer Credit \(https://ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit/\)](https://ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit/). Some departments and programs have additional restrictions on transfer credit. The Office of Academic Advising maintains the university's official list of [transfer credit advisors \(https://oaa.rice.edu/advising-network/transfer-credit-advisors/\)](https://oaa.rice.edu/advising-network/transfer-credit-advisors/) on their website: <https://oaa.rice.edu>. Students are encouraged to meet with their academic program's transfer credit advisor when considering transfer credit possibilities.

### Departmental Transfer Credit Guidelines

Students pursuing the major in Computational and Applied Mathematics should be aware of the following departmental transfer credit guidelines:

- Requests for transfer credit will be considered by the program director (and/or the program's official transfer credit advisor) on an individual case-by-case basis.

### Additional Information

For additional information, please see the Computational Applied Mathematics and Operations Research website: <https://www.caam.rice.edu/>.

# Opportunities for the BA Degree with a Major in Computational and Applied Mathematics

## Academic Honors

The university recognizes academic excellence achieved over an undergraduate's academic history at Rice. For information on university honors, please see [Latin Honors \(https://ga.rice.edu/undergraduate-students/honors-distinctions/university/\)](https://ga.rice.edu/undergraduate-students/honors-distinctions/university/) (*summa cum laude*, *magna cum laude*, and *cum laude*) and [Distinction in Research and Creative Work \(https://ga.rice.edu/undergraduate-students/honors-distinctions/university/\)](https://ga.rice.edu/undergraduate-students/honors-distinctions/university/). Some departments have department-specific Honors awards or designations.

## Fifth-Year Master's Degree Option for Rice Undergraduate Students

In certain situations and with some terminal master's degree programs, Rice students have an option to pursue a master's degree by adding an additional fifth year to their four years of undergraduate studies.

Advanced Rice undergraduate students in good academic standing typically apply to the master's degree program during their junior or senior year. Upon acceptance, depending on course load, financial aid status, and other variables, they may then start taking some required courses of the master's degree program. A plan of study will need to be approved by the student's undergraduate major advisor and the master's degree program director.

As part of this option and opportunity, Rice undergraduate students:

- must complete the requirements for a bachelor's degree and the master's degree independently of each other (i.e. no course may be counted toward the fulfillment of both degrees).
- should be aware there could be financial aid implications if the conversion of undergraduate coursework to that of graduate level reduces their earned undergraduate credit for any semester below that of full-time status (12 credit hours).
- more information on this *Undergraduate - Graduate Concurrent Enrollment* opportunity, including specific information on the registration process can be found [here \(https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/\)](https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/).

Rice undergraduate students completing studies in science and engineering may have the option to pursue the Master of Computational and Applied Mathematics (MCAAM) degree. For additional information, students should contact their undergraduate major advisor and the MCAAM program director.

## Additional Information

For additional information, please see the Computational Applied Mathematics and Operations Research website: <https://www.caam.rice.edu/>.