

# APPLIED AND COMPUTATIONAL MATHEMATICS

The Applied and Computational Mathematics (ACM) Master's program provides graduate-level education in applied mathematics. The program develops the principles of applied mathematics and statistics, and provides students with the skills to employ those principles in industrial or scientific settings. It has three central themes: general principles and theories of applied mathematics and statistics, the construction and analysis of mathematical and statistical models, and the development and efficient execution of computational mathematical algorithms. Effective use of advanced applied mathematical techniques has become increasingly important in industrial and scientific settings as the amount of sophisticated simulation software and specialized open-source packages has greatly increased. Professionals are needed to assist engineers, scientists and managers in the precise formulation of complex problems and in selecting the analytical methods and software appropriate for their solutions. These professionals should understand the algorithms underlying mathematical software and be able to implement additional mathematical algorithms knowledgeably and efficiently in the framework of existing software. Finally, these professionals need to interpret the results of computations for others. It is the goal of the program to equip students with these skills so that they will become professionals in the needed fields.

## The Program

The key components of this evening/late-afternoon program involve the integration of applied mathematics, mathematical modeling, numerical analysis and statistics. The ACM program provides not only coursework in various areas of applied mathematics, but also opportunities for independent or collaborative work. These approaches to learning contribute to a student's outlook and depth of understanding. The program supports the development and enhancement of students' skills in high-demand industrial and scientific careers, and in other careers that primarily focus on applied mathematics. It is geared toward three groups of prospective students: individuals in established careers who want or require further training for their current positions, individuals in the workforce who wish to retrain for new career directions, in some cases preparing for a more mathematically-oriented assignment with their current employer, and recent graduates who desire a deeper understanding of applied mathematics to help in launching a career.

## Admission and Prerequisites

Admission to the ACM program as a regular student requires a B.A. or a B.S. degree in mathematics, statistics, computer and information science, engineering, a physical science or a life science, earned in a program at an accredited institution with an average grade of *B* or better. Individuals with degrees in other fields not listed above or with grades less than a *B* average may be considered for conditional admission and may be required to submit evidence of potential for success in the ACM program. An entering student must have completed three courses in Calculus, including multivariate Calculus, plus introductory courses in Linear Algebra and Differential Equations. In exceptional cases, an applicant may be admitted without some prerequisite courses. If an applicant is admitted to the program without some prerequisite courses, the applicant must make up the missing prerequisites after entrance to the Graduate

Program. However, credits received in courses elected to make up the missing prerequisites do not count toward the degree.

Application instructions can be found at: <https://umdearborn.edu/admissions/graduate/how-apply> (<https://umdearborn.edu/admissions/graduate/how-apply/>)

A complete application consists of the following:

1. Official transcripts from all universities and colleges attended.
2. A one-page statement of purpose stating the applicant's career goals and personal objectives in pursuing the program.
3. Three letters of recommendation are required. At least one letter must address the applicant's academic background.
4. Students whose native language is not English are also required to satisfy the English Language Requirements for Admission which can be found in the General Information section of this catalog.

For more information, visit the ACM website (<https://umdearborn.edu/casl/graduate-programs/programs/master-science-applied-and-computational-mathematics/>) or call 313-583-6321.

Undergraduate students eligible to pursue the Applied and Computational Mathematics 4+1 option may count 4 courses (13 credits) in the graduate program toward their undergraduate Mathematics degree. At least one additional year of graduate work (17+ credits) after completing their undergraduate degree would be needed by the undergraduate students enrolled in the 4+1 option to complete the rest of the ACM's degree requirements. Undergraduate students interested in the 4+1 option are strongly encouraged to apply in their sophomore year and start the program in their junior year.

## Advanced Standing

Up to 6 credit hours, or their equivalent, toward the degree may be granted by the Graduate Program Committee to a student through the transfer of credit for approved graduate-level courses. These courses must have been completed within the past five years with a grade of *B* or better at an accredited institution with graduate degree programs and not have been applied in whole or in part toward another degree or certificate.

Graduate credit may be transferred from other University of Michigan campuses (Flint or Ann Arbor) for up to half of the credits required for the degree.

## Degree Requirements

**1. 30 semester hours of graduate course work with a cumulative grade point average of B or better.**

The 30 hours must be selected from approved courses listed below and be approved by the student's graduate advisor. At least 15 credit hours of the courses must be in Mathematics and Statistics.

In addition to the specific degree requirements listed here, the general Master's degree policies and requirements (<http://catalog.umd.umich.edu/academic-policies-graduate/>) also apply. Note: Students admitted prior to Summer 2019 to the Applied and Computational Math Master's Program fall under Rackham Graduate School Academic Policies (<https://rackham.umich.edu/academic-policies/>).

**2. One course from each of the following Core Areas A, B and C.**

Code	Title	Credit Hours
<b>Core Courses</b>		<b>9</b>
Select one course from each of the following areas A, B, and C:		
Area A: Mathematical Analysis		
MATH 551	Advanced Calculus <sup>1</sup>	
MATH 554	Fourier Series and Boundary Value Problems <sup>2</sup>	
MATH 555	Func of a Complex Var with App	
Area B: Numerical Methods		
MATH 572	Introduction to Numerical Analysis <sup>1</sup>	
Area C: Modeling		
MATH 562	Mathematical Modeling <sup>1</sup>	

**3. At least 4 courses from the Modeling Specialization Areas A, B and C listed below. Not all 4 courses can be from the same area.**

Equivalent courses taken elsewhere may be used to satisfy the requirement, but may not count toward the 30 hours (with the exception of the 6 hours specified in 1 above which may count toward the 30 hours).

Code	Title	Credit Hours
<b>Modeling Specialization Areas</b>		<b>12</b>
Select at least four courses from areas A, B and C. Not all four course may be from the same area.		
Area A: Linear and Discrete Models		
MATH 523	Applied Linear Algebra	
MATH 558	Introduction to Wavelets	
STAT 530	Applied Regression Analysis <sup>2</sup>	
Area B: Differential Models		
MATH 504	Dynamical Systems	
MATH 514	Finite Difference Methods for Differential Equations	
MATH 516	Finite Element Methods for Differential Equations	
MATH 554	Fourier Series and Boundary Value Problems <sup>2</sup>	
Area C: Statistical Models		
MATH 520	Stochastic Processes	
MATH 525	Mathematical Statistics	
STAT 530	Applied Regression Analysis <sup>2</sup>	
STAT 535	Data Analysis and Modeling <sup>2</sup>	
STAT 545	Reliability & Survival Analysis <sup>2</sup>	
STAT 550	Multivariate Stat Analysis <sup>2</sup>	
STAT 560	Time Series Analysis <sup>2</sup>	

<sup>1</sup> Students enrolled in the 4+1 option can double count Math 551, Math 562, and Math 572 toward both undergraduate math degree and ACM degree.

<sup>2</sup> Students enrolled in the 4+1 option can either double count Math 554 or Stat 530 or Stat 535 or Stat 545 or Stat 550 or Stat 560 toward both undergraduate math degree and ACM degree. Only **one** of these courses can double count.

**4. Independent Research Project, taken for three credits.**

Code	Title	Credit Hours
<b>Independent Research Project</b>		<b>3</b>
MATH 599	Independent Research Project	

**5. Approved Cognate Courses - Two course or 6 credit hours of cognates outside the Department of Mathematics and Statistics. The courses should be selected from the approved courses listed below<sup>3</sup>.**

Code	Title	Credit Hours
<b>Cognate Courses</b>		<b>6</b>
Select two courses from the following:		
Computer and Information Science		
CIS 505	Algorithm Analysis and Design	
CIS 515	Computer Graphics	
CIS 527	Computer Networks	
CIS 537	Advanced Networking and Distributed Systems	
CIS 544	Computer and Network Security	
CIS 551	Advanced Computer Graphics	
CIS 552	Information Visualization and Virtualization	
CIS 568	Data Mining	
CIS 574	Compiler Design	
CIS 575	Software Engineering Mgmt	
CIS 652	Advanced Information Visualization and Virtualization	
Economics		
ECON 5015	Introduction to Econometrics	
Electrical and Computer Engineering		
ECE 552	Fuzzy Systems	
ECE 555	Stochastic Processes	
ECE 560	Modern Control Theory	
ECE 565	Digital Control Systems	
ECE 567	Nonlinear Control Systems	
ECE 585	Pattern Recognition	
ECE 665	Optimal Control Systems	
Industrial and Manufacturing Systems Engineering		
IMSE 500	Models of Oper Research	
IMSE 505	Optimization	
IMSE 510	Probability & Statistical Mod	
IMSE 511	Design and Analysis of Exp	
IMSE 514	Multivariate Statistics	
IMSE 520	Managerial Decision Analysis	
IMSE 567	Reliability Analysis	
Management		
DS 570	Management Science	
OM 521	Operations Management	
OM 660	Supply Chain Analytics	
Mechanical Engineering		
ME 510	Finite Element Methods	
ME 518	Advanced Engineering Analysis	
Physics		

PHYS 503 Electricity & Magnetism

PHYS 553 Quantum Mechanics

<sup>3</sup> Exceptions can be made to use a course not from the above list as a cognate course. For such an exception, the student is required to receive an approval from the ACM Program Advisor **prior to** registering the course.

## Learning Goals

1. Comprehension of the principles and theories of applied mathematics and statistics.
2. Skill in the construction and analysis of mathematical models.
3. Skill in the analysis and development of efficient computational mathematical algorithms
4. Ability to apply the first three items in industrial and scientific settings.