Degree Requirements for BA in Mathematics

For general university requirements, see http://ga.rice.edu/UG_graduation Students majoring in mathematics may choose between the regular math major and the double major. Regular math majors must complete:

- MATH 101 and 102 Single Variable Calculus I and II
- MATH 211 or 220 Ordinary Differential Eqns./Honors ODEs and MATH 212 Multivariable Calculus; or MATH 221 and 222 Honors Calculus III and IV
- At least 24 semester hours (eight courses) in departmental courses at the 300 level or above (in many instances, the math department will waive the 100- and 200-level courses for a math major)

The requirements for the double major are the same except that students may substitute approved mathematics-related courses for up to nine of the 24 hours required at the 300 level or above. At most, students can take one course (three credit hours) for any given course number to use toward the degree.

Students receive advanced placement credit for MATH 101 by achieving a score of four or five on the AP AB-level test and for MATH 101 and 102 by achieving a score of four or five on the BC-level test. Students who have had calculus but have not taken the AP test may petition the department for a waiver of the calculus requirements. Entering students should enroll in the most advanced course commensurate with their background; advice is available from the mathematics faculty during Orientation Week and at other times.

Disclaimer: Official requirements for the BA in Mathematics Degree are posted in the General Announcements on the Registrar's website http://ga.rice.edu/programs.aspx?FID=2147483730 Please note that these are the definitive version.

Degree requirements for BS in Mathematics

These requirements are in addition to general university graduation requirements. The chair of the undergraduate committee of the MATH department may modify requirements to meet the needs of students with advanced backgrounds. Required courses include:

- Single variable calculus: MATH 101 and 102;
- Differential equations- one class of the following: MATH 211, 220, 381, or 423;
- Multivariable calculus: MATH 212, or both 221 and 222
- Linear algebra – one class from the following: MATH 221, 354, or 355;
- Real analysis - two classes from the following: MATH 321, 322, or 425;
- Algebra: MATH 356 and 357;
- Geometry and manifolds – one class from the following: MATH 370, 401, or 402;
- Complex analysis – one class from the following: MATH 382 or 427;
- Topology – one class from the following: MATH 443, 444, or 445;

A total of at least 33 credit hours in MATH (e.g., 11 three-hour courses) at the 300 level or above is required. Students may choose electives to reach this number. At most three credit hours for any given course number may be used for this degree.

Disclaimer: Official requirements for the BS in Mathematics are posted in the General Announcements on the Registrar's website http://ga.rice.edu/programs.aspx?FID=2147483730 Please note that these will be the definitive version.

Course requirements for a Minor in Mathematics

The minor in mathematics is available to students majoring in other fields who take at least 18 credit hours in MATH at the 200 level or above, including at least 12 credit hours at the 300 level or above. These are subject to the following breadth requirements – at least one course must be from each of the following areas:

Analysis

MATH 302 Elements of Analysis
MATH 321 Introduction to Analysis I
MATH 381 Introduction to Partial Differential Equations
MATH 382 Computational Complex Analysis

Discrete Mathematics and Algebra

MATH 306 Elements of Abstract Algebra
MATH 356 Abstract Algebra I
MATH 365 Number Theory
MATH 368 Topics in Combinatorics

Linear Algebra

MATH 221 Honors Calculus III
MATH 354 Honors Linear Algebra
MATH 355 Linear Algebra

Certain approved classes taken outside the mathematics department may be used to satisfy the breadth requirement in one area, but will not count towards the required 18 credit hours. An approved upper-level MATH course (other than 490 or 499) may be used to satisfy a breadth requirement. Students seeking to substitute approved courses should consult in advance with the chair of the undergraduate committee. At most three credit hours from any particular course or course number may be applied to the minor.

Disclaimer: Official requirements for a Minor in Mathematics Degree are posted in the General Announcements on the Registrar's website
https://ga.rice.edu/programs-study/departments-programs/natural-sciences/mathematics/mathematics-minor/#requirementstext
Please note that these are the definitive version.

MATH PLACEMENT INFORMATION FOR NEW STUDENTS
August 2021

Science-Engineering Calculus Sequence:

All Science/Engineering majors require some calculus courses. These courses should be taken in order, although 211 and 212 are interchangeable. Each of these courses is offered every semester.

MATH 101 – Single Variable Calculus I	(3 hours)
MATH 102 – Single Variable Calculus II	(3 hours)
MATH 211 – Ordinary Differential Equations	(3 hours)
MATH 212 – Multivariable Calculus	(3 hours)

Honors Calculus Courses:

MATH 220 – Honors Ord. Diff. Equations (F)	(3 hours)
MATH 221 – Honors Calculus III (F)	(3 hours) Prof. Jones
MATH 222 – Honors Calculus IV (S)	(3 hours)

The Mathematics department encourages students to consider the honors calculus courses if they have a strong math background and are either considering a major in an area with a substantial math component (e.g., CAAM, STAT, MTEC, COMP, ELEC, PHYS), or just enjoy a challenge and want to go beyond just learning to solve computational problems. Math 221/222 stress theoretical aspects of multivariable calculus, although they also contain a considerable amount of problem solving. Similarly, Math 220 covers the same material as in Math 211, but with more of an emphasis on theory. All of these courses teach students how to prove mathematical statements. It is not possible to receive credit for both Math 211 and 220, or for both Math 212 and 222, but it is possible to receive credit for both 212 and 221.

The MATH BA degree requires completion of either the sequence 211/220-212 or the sequence 221-222. However for other majors, successful completion of 221 and 222 satisfies requirements only for Math 212, but not for Math 211. Math 221-222 students are allowed to take Math 211/220 for credit.

Other Calculus Courses:

MATH 111	Calculus: Differentiation and its Applications (F)	(3 hours)
MATH 112	Calculus: Integration and its Applications (S)	(3 hours)

These courses emphasize problem solving, and do not go as far as 101-102. They are not intended for science or engineering majors, but a student may take 111, 112, and 102 (or 111, 101, and 102).

Non-Calculus Courses (for Distribution):

MATH 115	The Art of Mathematics (F)	(3 hours) Prof. Orcan

This course is intended for non-science/engineering students who don't want or need to take calculus, but desire to learn more about aspects of mathematical ideas and thinking that don't require a lot of algebraic formulas.

More Advanced Courses

Students who have already taken some or all of the above courses should also consider the following courses. Speak with a Math advisor to decide which would be the best fit for you.

MATH 321	Intro to Analysis I (F)	Prof. Lukic
MATH 331	Honors Real Analysis (F)	Prof. Semmes
MATH 354	Honors Linear Algebra (F/S)	Prof. Wolf
MATH 355	Linear Algebra (F/S)	Prof. Orcan-Ekmekci; Prof. Joseph
MATH 365	Number Theory (S)	
MATH 499	Math RTG Seminar (S*)	

*Tentative

Students who have taken multivariable calculus should consider Math 354 if they are interested in abstract math and might be a math major or double major. Among other things, Math 354 serves as a first class where students learn to prove mathematical statements. Math 321, 331, and 365 can only be taken by students who have had some prior exposure to proofs. First-year students should obtain consent from the instructor in order to enroll in Math 321 or Math 354.

Registration:

You should enroll in the course for which you are best suited in light of your previous calculus instruction. There are several guiding principles you may find helpful.

1. **Basic principle: *Enroll in a course as advanced as you can possibly handle.*** If you find you are in over your head, you may easily drop down to a more elementary course with the approval of your instructor: the registrar's office allows dropdowns in calculus (where you drop, e.g., Math 102 and add Math 101) as late as the 7th week of the semester. A transition in the other direction is much more difficult.
2. **No calculus background at all:** You should begin with Math 101 or 111.
3. **Advanced placement credit and International Baccalaureate credit:**
   a. AP Grade of 4 or 5 on AB test, or IB Mathematics (HL). You have credit for (the equivalent of) Math 101 and you may start with Math 102.
   b. AP Grade of 4 or 5 on BC test: You have credit for (the equivalent of) Math 101-102 and you may start with Math 211 or 212. You should consider Math 221 and/or 220 and/or 354/355 if you love math.
4. **Some calculus but no advanced placement credit:** If you have taken some calculus, you probably should enroll in a course beyond Math 101. Consult a math professor for advice. ***We are convinced that most science/engineering freshmen should skip at least Math 101.***
5. **Transfer credit from another university:** Consult with Prof. Jones for advice.
6. **Have taken multivariable calculus:** Talk to a math advisor**.** You should still strongly consider Math 221-222 (see also the discussion above).

Note: If you know the material for a course but do not officially have credit, it might be possible to skip it even if your major requires the course. Many departments allow you to skip a basic math requirement and take another math class in its place (e.g., a major requires 101 and 102, but you take 102 and 212). You should consult with your department before registering to understand its particular mathematics policies and requirements.

Diagnostic Self-Test for placement into Math 102

Many students enrolling at Rice have had some calculus. We recommend that most of these students enroll in Math 102 or a more advanced course. Math 101 is fundamentally for those students who have not seen calculus before. Any student who has difficulty with Math 102 has the option, at any point before the drop deadline, to drop back into Math 101 without penalty. Each student should attempt to enroll in the most appropriate course, and the advisers and members of the Mathematics Department can help in this process.

To help you decide if your calculus preparation is sufficient we suggest that familiarity with the problems below would represent sufficient background. In Math 102 these concepts would be used repeatedly thus enabling the students to gain more confidence in these ideas.

Sample Problems

1. $\dfrac{d}{dx}\sqrt{x\sin(2x^2)} =?$

2. Find $\dfrac{dy}{dx}$ at the point $(0,1)$ for the curve defined by $y^2 + xy = 4x + e^x$.

3. $\displaystyle\int_0^1 e^{2x+1}\,dx =?$

4. Find the area of the intersection of the two regions A and B:

$$A = \{(x,y)\ :\ y > x^2\} \qquad B = \{(x,y)\ :\ y < -x^2 + 1\}.$$

5. Without using a calculator, what is $(27.01)^{4/3}$ to two decimal places?

6. Find the maximum and minimum values of $f(x) = \dfrac{x}{x^2 - x + 1}$ on the interval $0 \le x \le 3$.

7. Calculate $\displaystyle\lim_{x\to\infty} \dfrac{3x^2 + x\ln x + 1}{5x^2 - 2x + 4}$.

If you have further questions please consult with members of the Mathematics Department who will be available during Orientation Week.

Diagnostic Self-Test for placement into Math 211/212

Many students entering Rice have had an entire year of calculus in high school. For some of these students it would be advisable to start in a 200-level course such as Math 211 or Math 212. (Note: Math 221/222 is an honors version of Math 212, and Math 238 is an honors version of Math 211; these are more theoretical courses for students with strong math backgrounds.) Any student who has difficulty with Math 211 or 212 has the option, at any point before the drop deadline, to drop back into Math 102 without penalty. Each student should attempt to enroll in the most appropriate course, and the advisers and members of the Mathematics Department can help in this process.

To help you decide if your calculus preparation is sufficient, we suggest that familiarity with the problems below would represent sufficient background.

Sample Problems

1. Find $\int xe^{3x}\,dx$.

2. $\int_0^\infty \dfrac{dx}{x^2+4} = ?$

3. Does the infinite series $\displaystyle\sum_{n=2}^{\infty} \dfrac{1}{n \ln n}$ converge?

4. Use a Taylor polynomial of degree three to estimate $\ln 1.1$. Without using a calculator, show that your estimate is within 0.0001 of the actual value.

5. Find the sum $\displaystyle\sum_{n=0}^{\infty} (-1)^n \dfrac{2^n x^n}{(2n)!}$.

6. Find a complex number z such that $e^z = 4i$.

If you have further questions please consult with members of the Mathematics Department who will be available during Orientation Week.