

# Technical Mathematics IV Syllabus

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## 1 Basic Information

**Course:** Technical Mathematics IV, 2030:154–204 75726

**Course Type:** Lecture

**Course Web Site:** <http://srandby.org/2018-2/154-204/home.html>

**Class Location:** Polsky 493

**Time and Dates:** 10:15–11:30 am, TuTh, 8/28/2018–12/6/2018

**Instructor:** Dr. Scott Randby

**Department:** Applied General and Technical Studies

**Phone:** 330–972–6094

**Email:** [srandby@uakron.edu](mailto:srandby@uakron.edu)

**Office:** Polsky 131F

**Office Hours**

**Tuesday:** 12:00–2:00 pm

**Thursday:** 12:00–2:00 pm

or by appointment

**Online Office Hours**

**Tuesday:** 12:00–2:00 pm

**Thursday:** 12:00–2:00 pm

or by appointment

**Exam Schedule**

**Exam 1:** 9/20

**Exam 2:** 10/11

**Exam 3:** 10/30

**Exam 4:** 11/20

**Final:** 12/13, 12:15–2:15 pm

**Optional Text:** *OpenStax Algebra and Trigonometry*. OpenStax CNX, 2017. <https://openstax.org/details/books/algebra-and-trigonometry>.

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## 2 Instructor and Student Roles

The relationship between the instructor and a student will be a professor-student relationship. This type of relationship is not employer-employee, commander-subordinate, parent-child, or friend-friend. The role of the professor in this class is to guide students through the course and

help students learn the course material. The role of the student is to learn the course material and demonstrate that learning on exams.

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### 3 Syllabus Policy

Students are required to download the syllabus from the homepage of the course website. The syllabus file is a PDF file which should be opened using a PDF reader.

It is the responsibility of every student to read and understand the syllabus.

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### 4 Email Policy

All students are required to check their `zips.uakron.edu` email account at least once a day.

Email is not sent out every day, but students are required to check their `zips.uakron.edu` account anyway.

Students are required to use their `zips.uakron.edu` email account when they send email to the instructor.

Email from the instructor to a student is sent only to the student's `zips.uakron.edu` account.

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### 5 Textbook

No textbook is used in this class. All course materials (homework assignments, class notes, class audio recordings, handouts, etc.) are posted on the course website.

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### 6 Calculator Requirement

All students are **required** to have a **graphing** calculator with minimum functionality equivalent to that of the **Texas Instruments TI-83** calculator.

Every student is **required** to have possession of their calculator by the end of the first week of classes.

Students are **required** to bring the required calculator to each class.

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### 7 Course Components

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#### 7.1 Attendance

Attendance will be taken at the beginning of each class.

Students are expected to attend every class, arrive to each class on time, and stay for the entire length of all classes.

Students who have excessive unexcused absences may be required to meet with Dr. Randby outside of class for a discussion about attendance.

Students are expected to take good notes during class (taking notes is an effective memory-retention technique that improves learning), participate in classroom discussions, and ask questions about material they do not understand.

Students should not use their electronic devices during class unless those devices are being used to take notes, to do computations, or to obtain electronic documents relevant to the course. Students using electronic devices in a manner that disrupts the class or distracts other students will be asked to turn off the devices and put them away.

Students are required to know what homework was assigned and what material was covered during a class whether or not they attended the class.

Important material is covered in every class.

Students are required to obtain notes and homework due date information from the course web site whenever they miss a class. Students are also required to complete homework assigned during a missed class and are expected to turn in such assignments on time.

Students are not permitted to bring children, family members, friends, or any other person to class for any reason.

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## **7.2 Homework**

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### **7.2.1 Homework Policies**

There will be a graded homework assignment for each section covered in class.

Each homework assignment is worth 10 points.

The due date for each graded assignment will be announced in class and posted on the course website.

Students are required to download the homework assignments from the homepage of the course website. The homework assignments file is a PDF file which should be opened using a PDF reader.

Students are required to have access to either a printed or electronic version of the homework assignments during every class.

The beginning of each class will be devoted to a discussion of homework problems. During this time, students may ask questions about the homework, correct mistakes on their assignments, and supply solutions to help others in the class. Homework will be turned in after the discussion has ended.

Electronic submissions of homework are not accepted.

**Homework Solutions:** Solutions to a homework assignment will be posted on the course website after the assignment is collected. It is the responsibility of the student to obtain and review the homework solutions.

Students are expected to turn in all homework assignments on time. A homework assignment is counted as late if it is not turned in by the end of class on the day it is due. Unless circumstances beyond a student's control prevent the student from turning a homework assignment in on time and the instructor agrees to give an extension, the following apply to unexcused late homework:

**1 class day late:** 5 point deduction

**2 or more class days late:** 10 point deduction

Students who have an excessive number of uncompleted or unexcused late assignments may be required to meet with Dr. Randby outside of class for a discussion about homework.

If a student has a valid and excusable reason for turning in a homework assignment late and informs the instructor in a timely manner, then the instructor may give an extension at his discretion.

Homework assignments are required to be organized and legible. An assignment is considered to be organized if the problems and parts of problems are clearly and correctly labeled and appear in the correct numerical or alphabetical order. An assignment is considered to be legible if the instructor can read it without difficulty. If the first submission of an assignment is not organized and legible, then the assignment will be returned with a deadline for submitting an organized and legible version.

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## 7.2.2 Homework Process

In order to learn the material covered in this course, students need to have good learning practices while working on homework. Scientific research into learning has shown that students who use certain "good" practices are more successful than students who don't use those practices. The following instructions are meant to encourage students to use good learning practices while working on a homework assignment.

1. View the lessons relevant to the homework on the course website, or download the lessons and work offline.
2. Review the notes you took in class that are relevant to the homework and compare them to the notes and audio on the course website. Fill in any gaps in your notes.
3. Work through the homework problems referring to your notes and the relevant lessons on the course website when necessary.
4. Once a homework assignment is complete, it should be redone at least once (preferably more than once) without using notes.
5. Graded homework assignments should be examined for errors and corrected using the solutions posted on the course website. If a graded homework assignment has a low grade, then it should be redone correctly at least twice.

Do not consider a homework assignment to be completed until you thoroughly understand the

assignment. If there is something about an assignment you do not understand, then obtain help by either asking questions about the assignment when it is discussed in class, visiting Dr. Randby in his office during his office hours, making an appointment to meet with Dr. Randby in his office and meeting with him during the appointment's time, visiting the online help room during Dr. Randby's online office hours, making an appointment to meet with Dr. Randby in the online help room and meeting with him in the help room during the appointment's time, or sending an email message to [srandby@uakron.edu](mailto:srandby@uakron.edu) asking for help.

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### 7.2.3 Homework Grading

#### Homework Grading Philosophy

- Students need to figure out what they've done wrong on a homework assignment. The instructor can only point out and explain errors. Students need to do the hard work of understanding their errors.
- Studies show that doing the hard work of finding and fixing errors leads to better comprehension than just looking at errors pointed out by the instructor.

#### Problem Grading

- Each problem or part of a problem on a homework assignment is graded on a 0–1 point scale.
- Problems with incorrect work are marked.
- If nothing specific is marked on a problem, then it is up to the student to determine what is wrong about the solution by comparing the work to the solution posted on the course website.
- Sometimes problems with incorrect work will not be marked. Again, it is the responsibility of the student to determine if the work on non-marked problems is correct by comparing the work to the posted solutions.
- Points
  - Problem not attempted (NA): -1
  - Problem solution not complete (I): -0.5
  - Required work missing (RWM): -0.5 or less

#### Assignment Grades

- The points earned on an assignment's problems are totaled, the point total is divided by the maximum possible point total, the result of the division is multiplied by 10, and the result of the multiplication is rounded to the nearest 1/10th. The rounded number is the grade on the homework assignment.
- Earning a 10 on an assignment does not mean that all work is correct. Students are responsible for reviewing posted solutions and making sure all of their work is correct—even work with no red marks.

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## 7.3 Exams

Each exam is worth 100 points and will be based on the material previously covered in class.

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### 7.3.1 Exam Schedule

The dates of the exams appear below.

**Exam 1:** 9/20

**Exam 2:** 10/11

**Exam 3:** 10/30

**Exam 4:** 11/20

**Final:** 12/13, 12:15–2:15 pm

The exam schedule may be altered by the instructor if necessary.

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### 7.3.2 Preparing for an Exam

Scientific research into learning has shown that students who use certain “good” practices when preparing for an exam are more successful than students who don’t use those practices. The following instructions are meant to encourage students to use good practices when preparing for an exam.

1. Work through each homework assignment one time referring to your graded homework assignments, notes, and the lessons and solutions posted online when necessary.
2. Work through each homework assignment again without referring to any other materials. Once you are finished, fix any errors by referring to other materials.
3. Repeat step 2 until there are no errors in your work, and you have most or all of the solutions memorized.

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### 7.3.3 Exam Policies

Students are required to arrange their schedules so that they arrive to all exams on time. Students who are late to an exam may not disturb other students in any way, and they will be given the exam only after all other students are settled.

Early exams will not be given for any reason.

All students are required to bring a graphing calculator to the exam. Students may not borrow a calculator from another student or the instructor during the exam.

Students are not permitted to use scrap paper, red pens, or red pencils during an exam.

Except for approved calculators, students are not permitted to use electronic devices (smartphones, cell phones, headphones, earbuds, etc.) during an exam unless the use of such devices meets an accommodation requirement or their use has been approved by the instructor prior to the exam. These devices are not permitted to be visible and they may not make any sounds during an exam (unless their use is permitted of course). Students may not leave the class during an exam to use an electronic device for any reason.

Students are required to turn in all materials they have received from the instructor after completing an exam.

Students are required to finish their exams by the end of the class period. Students who arrive late to an exam will not be given a time extension.

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### 7.3.4 Make-up Exams

Students are required to take every exam during its scheduled date and time unless Dr. Randby agrees to schedule a make-up exam.

It is the responsibility of a student to request a make-up exam. Dr. Randby reserves the right to require a student to provide additional information or documentation whenever a student requests a make-up exam.

Make-up exams are given at the discretion of Dr. Randby. Requesting a make-up exam does not guarantee that a make-up exam will be granted. Some of the factors that are taken into account when determining whether or not to grant a make-up exam request are (1) the reason for the request, (2) the length of time between the exam and the submission of the request, (3) attendance, (4) homework completion, and (5) the number of previous make-ups. A make-up exam will not be granted if the reason for the request is either not exceptional or not beyond the control of the student or both.

Make-up exam requests for participation in a university-sponsored event, jury duty, or military service require documentation. Students are required to supply Dr. Randby with documentation in PDF form.

A make-up exam will only be given on campus in the presence of Dr. Randby.

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### 7.3.5 Understanding Exam Grades

Each problem or part of a problem on an exam is graded on a 0–1 point scale in increments of 1/10th of a point. The points are totaled, the point total is divided by the maximum possible point total, the result of the division is multiplied by 100, and the result of the multiplication is rounded to the nearest 1/10th. The rounded number is the grade on the exam.

The following questions are asked when an exam problem is graded:

1. Does the solution demonstrate an understanding of the concepts and methods covered in class that are relevant to the problem?
2. Does the solution use the required and proper techniques and methods?
3. Is the solution presented in a logical and coherent manner?
4. Does the solution use notation properly and correctly?
5. Are the theoretical and numerical computations that appear in the solution correct?
6. Are the numerical values that appear in the solution correct?
7. Is the solution succinct and to-the-point?
8. Is the solution clear and unambiguous?



## Problem Grading

- 0: Perfect work
- 0.1: A work with minor errors
- 0.2: B work
- 0.3: C work
- 0.4: D work
- 0.5: F work
- 1.0: No work or required work missing

When graded exams are returned to a student, only the student's graded work is returned. The sheet containing the exam problems is not returned. The reason for this practice is that exams are not learning tools, they are where students demonstrate learning. If there appears to be a grading error on an exam or if the grading is not understood, then a student should meet with Dr. Randby to discuss the grading.

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## 8 Course Grade

Your *numerical course grade*  $G$  consists of *course homework points* ( $H$ ) and *course exam points* ( $E$ ). The maximum value of  $H$  is 15, the maximum value of  $E$  is 85, and the maximum value of  $G$  is 100.

Use the following to determine  $G$ .

$hnum$  = the number of graded homework assignments

$hmax$  = the maximum possible points on a homework assignment

$hsum$  = the sum of the scores of the graded homework assignments

$enum$  = the number of graded exams

$emax$  = the maximum possible points on an exam

$esum$  = the sum of the scores of the graded exams

$$H = \frac{15 \cdot hsum}{hnum \cdot hmax}$$

$$E = \frac{85 \cdot esum}{enum \cdot emax}$$

$$G = H + E$$

Use the numerical course grade and the following list to determine your course letter grade.

A if  $91 \leq G \leq 100$

A- if  $90 \leq G < 91$

B+ if  $87 \leq G < 90$

B if  $81 \leq G < 87$

B- if  $80 \leq G < 81$

C+ if  $77 \leq G < 80$

C if  $71 \leq G < 77$

C- if  $70 \leq G < 71$

D+ if  $67 \leq G < 70$

D if  $63 \leq G < 67$

D- if  $60 \leq G < 63$

F if  $G < 60$

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## 9 Course Website

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### 9.1 Homepage

The address of the homepage of the course website is the following:

**Homepage:** <http://srandby.org/2018-2/154-204/home.html>

The homepage may also be accessed via the learning management system operated by the university.

The homepage contains links to the syllabus, homework assignments, and other information about the course.

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### 9.2 Lessons

Class notes, audio recorded during class, homework assignment due dates, and other information relevant to each class are given on the *Lessons* web page available at the following address:

**Lessons page:** <http://srandby.org/2018-2/154-204/lessons.html>

Students are required to obtain notes and homework due date information from the *Lessons* page whenever they miss a class.

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### 9.3 Help

Instructions for getting help are given on the *Help* web page available at the following address:

**Help page:** <http://srandby.org/2018-2/154-204/help.html>

The following information is given on the *Help* page.

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#### 9.3.1 Office Hours

Dr. Randby will be available in Polsky 131F during the following days and times:

**Tuesday:** 12:00–2:00 pm

**Thursday:** 12:00–2:00 pm

If Dr. Randby is not in his office during one of the above times and he has not previously announced that he will not be there, then students should assume there is a legitimate reason for his absence. Students may either wait to see if Dr. Randby returns to his office before the end of the help period, obtain help during the next scheduled help period, or send an email to [srandby@uakron.edu](mailto:srandby@uakron.edu) asking for help in Dr. Randby's office at a different time.

If a student wishes to meet with the Dr. Randby at a time not listed above, then that student should see him in person to arrange a meeting or send an email requesting a meeting to [srandby@uakron.edu](mailto:srandby@uakron.edu).

Students may come to Polsky 131F anytime, not just during office hours. If Dr. Randby is in the office when a student arrives and he is not working on something urgent, then he will be happy to help the student.

Please note that office hours are for discussing homework problems, clarifying concepts discussed in class, and discussing general mathematical issues.

Whenever a student goes to Dr. Randby's office for help, the student should bring relevant class notes, a copy of any relevant homework assignments, any work the student has done, a calculator, a writing instrument, and paper.

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### 9.3.2 Online Help

Students may communicate in real time (audio, video, chat, screen sharing) with Dr. Randby in a Jitsi Meet room. You may access the room by clicking on the following link:

**Online help room:** <https://meet.jit.si/DrRandbyOnlineOffice>

Dr. Randby will be available in the online help room during the following days and times:

**Tuesday:** 12:00–2:00 pm

**Thursday:** 12:00–2:00 pm

If Dr. Randby is not in the online help room during one of the above times and he has not previously announced that he will not be there, then students should assume there is a legitimate reason for his absence. Students may either wait to see if Dr. Randby enters the online help room before the end of the help period, obtain help during the next scheduled help period, or send an email to [srandby@uakron.edu](mailto:srandby@uakron.edu) asking for help in the online help room at a different time.

If a student wishes to meet with Dr. Randby in the online help room at a time not listed above, then that student should send an email requesting an online meeting to [srandby@uakron.edu](mailto:srandby@uakron.edu).

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### 9.3.3 Email Help

Students may send questions about the course lessons and homework assignments to Dr. Randby via email. Questions should be sent to [srandby@uakron.edu](mailto:srandby@uakron.edu) from a `zips.uakron.edu` account. Questions sent from accounts other than `zips.uakron.edu` accounts will not receive a response.

Questions sent via email will receive a response within 24 hours after they are sent unless special circumstances prevent Dr. Randby from replying during that time period.

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### 9.3.4 University Tutoring

Information about tutoring services is available at the following link:

## UA Tutoring Services

<https://www.uakron.edu/tutoring/>

Online tutoring services are available at the following link:

## Online Tutoring Services

<https://www.etutoring.org/login.cfm?institutionid=263>

Please note that Dr. Randby does not vouch for the quality, knowledge, or ability of any tutor on or off the campus.

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# 10 Course Content and Objectives

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## 10.1 Bulletin Description

Prerequisites: 2030:153 or equivalent with a grade of C– or better, or placement test. Functions and their graphs, polynomial and rational functions, polynomial equations, graphs of trigonometric functions, trigonometric identities and equations, analytic geometry, complex numbers in polar form.

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## 10.2 Course Objectives

After completing this course the student should have the following competencies:

1. the ability to use a graphing calculator to solve a wide range of mathematical problems;
2. a complete understanding of graphs of polynomial functions including the concepts of relative maxima and minima, and increasing or decreasing intervals;
3. a complete understanding of graphs of rational functions including the concepts of vertical and horizontal asymptotes;
4. the ability to use a graphing approach to find the roots of polynomial functions of higher degree;
5. a complete understanding of the graphs of trigonometric functions including the concepts of amplitude, frequency, and phase shift;
6. an understanding of simple harmonic motion applications;
7. the ability to reproduce and use the most important trigonometric identities;
8. an understanding of the inverse trigonometric functions;
9. the ability to use the trigonometric and exponential forms of complex numbers.

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## 10.3 Course Outline

1. Essential algebra topics for calculus
  - (a) Operations with algebraic expressions
  - (b) Exponents and radicals
  - (c) Difference quotients
2. Functions and their graphs

- (a) Definitions of a function, domain, range
  - (b) Continuity
  - (c) Increasing and decreasing functions
  - (d) Relative maxima and minima
  - (e) Symmetry, even and odd functions
  - (f) Piecewise defined functions
  - (g) Operations on functions, composition of functions
3. Polynomial and rational functions
- (a) Polynomial functions and their graphs
  - (b) Real solutions of polynomial equations
  - (c) Complex solutions of polynomial equations
  - (d) Rational functions and their graphs
  - (e) Vertical and horizontal asymptotes
4. Analytic geometry
- (a) The circle
  - (b) The parabola (optional)
  - (c) The ellipse (optional)
  - (d) The hyperbola (optional)
  - (e) Translation of axes
  - (f) The general second-degree equation
5. Graphing the trigonometric functions
- (a) Graphing the sine and cosine functions
  - (b) Phase shift
  - (c) Graphing the other trigonometric functions
  - (d) Graphing composite curves
  - (e) Simple harmonic motion
6. Trigonometric formulas and identities
- (a) Basic trigonometric identities
  - (b) Sum and difference formulas
  - (c) Double- and half-angle formulas
  - (d) Trigonometric equations
  - (e) Inverse trigonometric relations
  - (f) Inverse trigonometric functions
7. Complex numbers
- (a) Trigonometric and exponential forms of complex numbers
  - (b) Multiplication and division of complex numbers
  - (c) Power and roots

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## 11 University Policies

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### 11.1 Undergraduate Bulletin

The university policies that affect students are contained in the *Undergraduate Bulletin*. To view the *Undergraduate Bulletin*, go to the following address:

## Undergraduate Bulletin

[https://www.uakron.edu/academics\\_majors/ub/](https://www.uakron.edu/academics_majors/ub/)

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### 11.2 Attendance Policy

The official attendance policy of the university is presented on the *Important Policies* page of the *Undergraduate Bulletin*.

#### Important Policies

[https://www.uakron.edu/academics\\_majors/ub/important-policies/](https://www.uakron.edu/academics_majors/ub/important-policies/)

A student is expected to attend all class meetings for which the student is registered. A student may be dropped from a course in the current term by the dean if absence is repeated and the instructor recommends this action; a student can gain re-admission only with permission of both the instructor and the dean. A student dropped from a course receives an “F” which counts as work attempted whenever grade-point ratio calculations are made.

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### 11.3 Incomplete Policy

The official incomplete policy of the university is presented on the *Grade Policy and Credit* page of the *Undergraduate Bulletin*.

#### Grade Policy and Credit

[https://www.uakron.edu/academics\\_majors/ub/important-policies/grade-policy-and-credit.dot](https://www.uakron.edu/academics_majors/ub/important-policies/grade-policy-and-credit.dot)

Students are expected to read and understand the official incomplete policy.

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### 11.4 Withdrawal Policy

The official withdrawal policy of the university is presented on the *Important Policies* page of the *Undergraduate Bulletin*.

#### Important Policies

[https://www.uakron.edu/academics\\_majors/ub/important-policies/](https://www.uakron.edu/academics_majors/ub/important-policies/)

Students are expected to read and understand the official withdrawal policy.

The withdrawal deadline for this course is **Sunday, October 14**.

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## 12 Academic Honesty and Student Conduct

Students are required to maintain the highest level of academic honesty in this course. The university’s academic honesty expectations are contained in the *Grade Policies and Credit* page of the *Undergraduate Bulletin* and in section 3359-41-01 of the *University Rules* (see <https://www.uakron.edu/ogc/UniversityRules/pdf/41-01.pdf>).

Students are required to follow The University of Akron's *Code of Student Conduct*. The *Code of Student Conduct* is available on the website of the *Student Conduct and Community Standards* office. See the following links for more information:

**Student Conduct and Community Standards**

<https://www.uakron.edu/studentconduct/>

**Code of Student Conduct**

<https://www.uakron.edu/ogc/UniversityRules/pdf/41-01.pdf>

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## 13 Accessibility, Counseling, and Health Services

Students who require special services and/or accommodations in the course should submit a request to the *Office of Accessibility* (OA) in a timely manner. The OA is located in Simmons Hall Room 105, and it may be contacted at 330-972-7928 (v), 330-972-5764 (tdd), or [access@uakron.edu](mailto:access@uakron.edu). See the following link for more information.

**Office of Accessibility**

<https://www.uakron.edu/access/>

Currently enrolled students may obtain free psychological services at the *Counseling & Testing Center*. See the following link for more information.

**Counseling & Testing Center**

<https://www.uakron.edu/counseling/>

Currently enrolled students may obtain free or low cost health services at *Student Health Services*. See the following link for more information.

**Student Health Services**

<https://www.uakron.edu/healthservices/>

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## 14 Title IX at UA

The University of Akron is committed to providing an environment free of all forms of discrimination, including sexual violence and sexual harassment. This includes instances of attempted and/or completed sexual assault, domestic and dating violence, gender-based stalking, and sexual harassment. If you (or someone you know) has experienced or experiences sexual violence or sexual harassment, know that you are not alone. Help is available, regardless of when the violence or harassment occurred, and even if the person who did this is not a student, faculty or staff member.

Confidential help is available. If you wish to speak to a professional, in confidence, please contact:

**University Counseling and Testing Center**

**Website:** <https://uakron.edu/counseling/>

**Phone:** 330-972-7082

## University Health Services

Website: <https://uakron.edu/healthservices/>

Phone: 330-972-7808

Please know the majority of other University of Akron employees, including faculty members, are considered to be “responsible employees” under the law and are required to report sexual harassment and sexual violence. If you tell me about a situation, I will be required to report it to the Title IX Coordinator and possibly the police. You will still have options about how your case will be handled, including whether or not you wish to pursue a law enforcement or complaint process. You have a range of options available and we want to ensure you have access to the resources you need.

Additional information, resources, support and the University of Akron protocols for responding to sexual violence are available at <https://uakron.edu/Title-IX/>.

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## 15 Formula Policy

*The formulas that students are required to know by heart at the beginning of this course are listed below.*

### Factoring Formulas

$$a^2 - b^2 = (a - b)(a + b)$$

$$x^2 + (a + b)x + ab = (x + a)(x + b)$$

$$acx^2 + (ad + bc)x + bd = (ax + b)(cx + d)$$

### Quadratic Formula

Let  $ax^2 + bx + c = 0$  where  $a$ ,  $b$ , and  $c$  are constants with  $a \neq 0$ .

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

### Equations of Lines

Assume a line passes through  $(x_1, y_1)$  and  $(x_2, y_2)$  with slope  $m$  and  $y$ -intercept  $b$ .

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad y - y_1 = m(x - x_1) \quad y = mx + b$$

### Distance Formula

Let  $d$  be the distance between  $(x_1, y_1)$  and  $(x_2, y_2)$ .

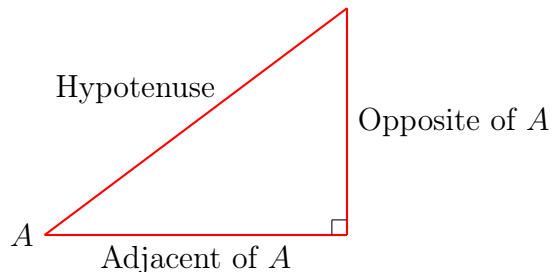
$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$



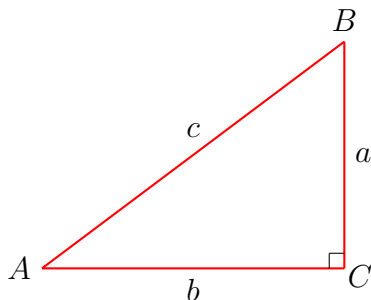
## Parallel and Perpendicular Lines

Suppose two lines have slopes  $m_1$  and  $m_2$  respectively. If the lines are parallel, then  $m_1 = m_2$ . If the lines are perpendicular, then  $m_2 = -1/m_1$ .

## Right Triangle Trigonometry



$$\begin{array}{lll} \sin(A) = \frac{\text{Opposite of } A}{\text{Hypotenuse}} & \cos(A) = \frac{\text{Adjacent of } A}{\text{Hypotenuse}} & \tan(A) = \frac{\text{Opposite of } A}{\text{Adjacent of } A} \\ \csc(A) = \frac{\text{Hypotenuse}}{\text{Opposite of } A} & \sec(A) = \frac{\text{Hypotenuse}}{\text{Adjacent of } A} & \cot(A) = \frac{\text{Adjacent of } A}{\text{Opposite of } A} \end{array}$$



$$a^2 + b^2 = c^2 \quad A + B = 90^\circ$$

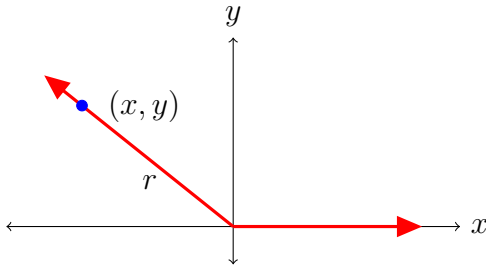
$$\begin{array}{lll} \sin(A) = a/c & \cos(A) = b/c & \tan(A) = a/b \\ \csc(A) = c/a & \sec(A) = c/b & \cot(A) = b/a \\ \sin(B) = b/c & \cos(B) = a/c & \tan(B) = b/a \\ \csc(B) = c/b & \sec(B) = c/a & \cot(B) = a/b \end{array}$$

$$A = \sin^{-1}(a/c) = \cos^{-1}(b/c) = \tan^{-1}(a/b)$$

$$B = \sin^{-1}(b/c) = \cos^{-1}(a/c) = \tan^{-1}(b/a)$$

## General Trigonometry

Angle  $\theta$  is shown below in standard position. The initial side of  $\theta$  is the positive  $x$ -axis, and the vertex of  $\theta$  is the origin  $((0,0))$ . Point  $(x,y)$  is a point on the terminal side of  $\theta$ , and  $r$  is the distance from  $(0,0)$  to  $(x,y)$ .



$$\begin{aligned}r^2 &= x^2 + y^2 \\ \sin(\theta) &= y/r & \csc(\theta) &= r/y \\ \cos(\theta) &= x/r & \sec(\theta) &= r/x \\ \tan(\theta) &= y/x & \cot(\theta) &= x/y\end{aligned}$$

## Radian Measure

$$180^\circ = \pi \text{ radians}$$

Let  $\theta$  be the radian measure of a central angle of a circle with radius  $r$ . Let  $s$  be the length of the circular arc intercepted by  $\theta$ , and  $A$  the area of the circular sector made by  $\theta$ .

$$s = r\theta \quad A = \frac{1}{2}r^2\theta$$

## Factoring Formulas

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2) \quad a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

## Product Formulas

$$(a \pm b)^2 = a^2 \pm 2ab + b^2 \quad (a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3$$

## Exponents

$$a^{-n} = \frac{1}{a^n} \quad a^{m/n} = (\sqrt[n]{a})^m = \sqrt[n]{a^m}$$

## Logarithms

$$\log_b(mn) = \log_b(m) + \log_b(n) \quad (m > 0, n > 0)$$

$$\log_b\left(\frac{m}{n}\right) = \log_b(m) - \log_b(n) \quad (m > 0, n > 0)$$

$$\log_b(m^n) = n \log_b(m) \quad (m > 0) \quad \log_b(b) = 1 \quad \log_b(1) = 0$$

$$\log(m) = \log_{10}(m) \quad \ln(m) = \log_e(m) \quad \log_b(m) = \frac{\log_a(m)}{\log_a(b)}$$

*Some of the formulas that students will know by heart at the end of this course are listed below.*

### **Fundamental Trigonometric Identities**

$$\csc(x) = \frac{1}{\sin(x)} \quad \sec(x) = \frac{1}{\cos(x)} \quad \cot(x) = \frac{1}{\tan(x)}$$

$$\tan(x) = \frac{\sin(x)}{\cos(x)} \quad \cot(x) = \frac{\cos(x)}{\sin(x)}$$

$$\sin^2(x) + \cos^2(x) = 1 \quad \sin(2x) = 2 \sin(x) \cos(x)$$

$$\sin^2(x) = \frac{1 - \cos(2x)}{2} \quad \cos^2(x) = \frac{1 + \cos(2x)}{2}$$