Technical Mathematics III

Table of Contents

1 Course Description 1

2 Course Outcomes 1

3 General Education Learning Outcomes 2

4 Course Outline 2

5 Textbook 3

6 Calculator Policy 3

7 Artifact 3

8 Formula Policy 4

1 Course Description

Course: 2030:153 Technical Mathematics III
Credits: 2
Prerequisites: 2030:152 or equivalent with a grade of C− or better, or placement test.
Bulletin Description: Prerequisites: 2030:152 or equivalent with a grade of C− or better, or placement test. Factoring, algebraic fractions, exponents and radicals, equations with radicals, equations in quadratic form, functions, their properties and graphs, exponential and logarithmic functions, radian measure.

2 Course Outcomes

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

1. the ability to use basic factoring techniques;
2. an understanding of fractions with variables;
3. the ability to work with integral and fractional exponents;
4. the ability to solve equations with radicals or in quadratic form;
5. an understanding of functions including the definition of a function, function notation, evaluation of functions, and the concepts of domain and range;
6. an understanding of the relationship between a function and its graph;
7. the ability to perform some operations on functions (addition, subtraction, multiplication, division);
8. a complete understanding of exponential and logarithmic functions and their graphs;
9. the ability to use radian measure of angles in theoretical and real-world applications.

3 General Education Learning Outcomes

Students will demonstrate foundational competency in creating and evaluating reasoned arguments and employing quantitative, qualitative, and normative information in such arguments. In particular, students employ the appropriate analysis and application of quantitative information, such that they:

1. Identify the value and limitations of magnitude (i.e., how large) and multitude (i.e., how many) measures;
2. Manipulate and express such measures with arithmetic, algebraic, geometric, and statistical methods;
3. Manipulate and express such measures with graphs, charts, and tables;
4. Manipulate and express such measures to solve practical and multistage problems.

In the course outline given below, a bold number indicates that the associated topic addresses the general education learning outcome with that number.

4 Course Outline

1. Factoring **1**, **2**
   (a) Special products: product of two binomials, square of a binomial, cube of a binomial
   (b) Factoring out a common factor
   (c) Factoring the difference of two squares, sum and difference of two cubes
   (d) Factoring trinomials
   (e) Factoring by grouping
2. Algebraic fractions **4**
   (a) Equivalent fractions
   (b) Reducing fractions
   (c) Multiplication and division of algebraic fractions
   (d) Addition and subtraction of algebraic fractions
3. Exponents and radicals
   (a) Integral exponents
   (b) Fractional exponents
   (c) Equations with radicals
   (d) Equations in quadratic form including complex solutions to quadratic equations **1**, **4**
4. Functions
   (a) Definition of a function, function notation, types of functions
   (b) Evaluation of a function **2**
   (c) The domain and range of a function expressed using inequality and interval notations **1**, **2**
   (d) Graphs of functions **1**, **3**
   (e) The relationship between a function and its graph (obtaining information from or

about the graph of a function) **3**
   (f) Operations on functions (addition, subtraction, multiplication, division) **2**, **4**
5. Exponentials and logarithms
   (a) The exponential function **1**, **3**
   (b) The logarithm **1**, **3**
   (c) Properties of logarithms
   (d) Common logarithms
   (e) Natural logarithms
   (f) Solving exponential equations **2**, **4**
   (g) Solving logarithmic equations **2**, **4**
6. Trigonometric functions
   (a) Radian measure of angles **1**, **2**
   (b) Applications of radian measure **4**
7. (Optional) Progressions and the Binomial Theorem
   (a) Arithmetic progressions
   (b) Geometric progressions
   (c) The Binomial Theorem

5 Textbook

OpenStax Algebra and Trigonometry. OpenStax CNX, 2017. https://openstax.org/details/books/algebra-and-trigonometry.

Chapter 1: 1.2, 1.3, 1.4, 1.5, 1.6
Chapter 2: 2.1, 2.6
Chapter 3: 3.1, 3.2
Chapter 5: 5.3, 5.4
Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6
Chapter 7: 7.1 (radians only), 7.3 (radians only), 7.4 (radians only)
Chapter 13: 13.1 (optional), 13.2 (optional), 13.3 (optional), 13.6 (optional)
Supplemental material needed: Laws of exponents, fractional exponents, multiplication and division of polynomials, factoring, rational expressions

6 Calculator Policy

All students are **required** to have a **scientific** or graphing calculator with minimum functionality equivalent to that of the **Texas Instruments TI–30X IIS** calculator. Every student is **required** to have possession of their calculator by the end of the first week of classes. No exceptions to this policy will be made by the instructor.

7 Artifact

During selected semesters, a student-produced artifact to be used for formative assessment of the effectiveness of the university's general education program will be collected, scanned, and

stored securely. The artifact is the comprehensive final exam given at the end of the course.

8 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.

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

Distance Formula

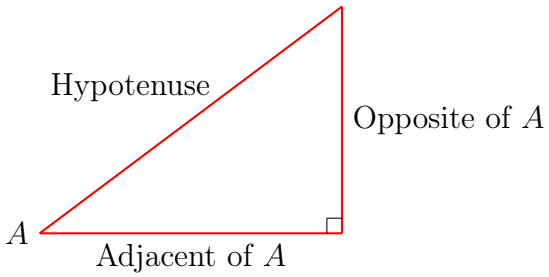
Let d be the distance between (x_1, y_1) and (x_2, y_2).

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

Parallel and Perpendicular Lines

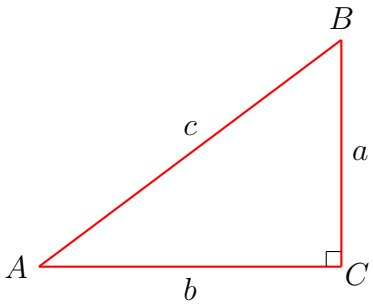
Suppose two lines have slopes m_1 and m_2 respectively. If the lines are parallel, then $m_1 = m_2$. If the lines are perpendicular, then $m_2 = -1/m_1$.

Right Triangle Trigonometry



$$\sin(A) = \frac{\text{Opposite of } A}{\text{Hypotenuse}} \qquad \cos(A) = \frac{\text{Adjacent of } A}{\text{Hypotenuse}} \qquad \tan(A) = \frac{\text{Opposite of } A}{\text{Adjacent of } A}$$

$$\csc(A) = \frac{\text{Hypotenuse}}{\text{Opposite of } A} \qquad \sec(A) = \frac{\text{Hypotenuse}}{\text{Adjacent of } A} \qquad \cot(A) = \frac{\text{Adjacent of } A}{\text{Opposite of } A}$$



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

$$\sin(A) = a/c \qquad \cos(A) = b/c \qquad \tan(A) = a/b$$

$$\csc(A) = c/a \qquad \sec(A) = c/b \qquad \cot(A) = b/a$$

$$\sin(B) = b/c \qquad \cos(B) = a/c \qquad \tan(B) = b/a$$

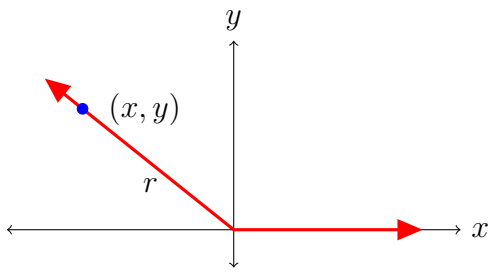
$$\csc(B) = c/b \qquad \sec(B) = c/a \qquad \cot(B) = a/b$$

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

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

General Trigonometry

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



$$r^2 = x^2 + y^2$$

$$\sin(\theta) = y/r \qquad \cos(\theta) = x/r \qquad \tan(\theta) = y/x$$

$$\csc(\theta) = r/y \qquad \sec(\theta) = r/x \qquad \cot(\theta) = x/y$$

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

Factoring Formulas

$$a^3 - b^3 = (a-b)\left(a^2 + ab + b^2\right) \qquad a^3 + b^3 = (a+b)\left(a^2 - ab + b^2\right)$$

Product Formulas

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

Exponents

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

Radian Measure

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

Let θ 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 θ, and A the area of the circular sector made by θ.

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

Logarithms

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

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

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

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