Technical Mathematics II

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1 Course Description

Course: 2030:152 Technical Mathematics II
Credits: 2
Prerequisites: 2030:151 or equivalent with a grade of C− or better, or placement test.
Bulletin Description: Prerequisites: 2030:151 or equivalent with a grade of C− or better, or placement test. Variation, equations of lines, Cramer's rule, right triangle trigonometry, oblique triangles, complex numbers.

2 Course Outcomes

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

1. a complete understanding of the properties and equations of lines;
2. an understanding of basic right-triangle trigonometry and trigonometric functions;
3. the ability to apply right-triangle trigonometry to real-world situations;
4. the ability to use the laws of sines and cosines properly;
5. the ability to solve problems using ratios, proportions, and variation;
6. the ability to use determinants and Cramer's rule to solve systems of linear equations;
7. the ability to perform basic arithmetical operations using complex numbers.

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. Lines
   (a) The concept of slope **1**, **2**
   (b) Graphing a line using its slope **1**, **3**
   (c) Finding the slope-intercept and general forms of a line
   (d) Finding the slope-intercept form given a general form
   (e) Horizontal and vertical lines
   (f) Parallel and perpendicular lines
   (g) Distance between two points **1**, **2**
   (h) Midpoint of a line segment
2. Right-triangle trigonometry
   (a) Angles, measuring angles using degrees **1**
   (b) Defining the six trigonometric ratios
   (c) Computing the value of a trigonometric ratio using a calculator **1**, **2**
   (d) Using inverse trigonometric functions to find acute angles **2**
   (e) Solving right triangles **2**, **4**
   (f) Applications of right-triangle trigonometry **4**
3. Trigonometric functions
   (a) Angles made by rotation, measuring angles in standard position, coterminal angles **1**
   (b) Defining the six trigonometric functions
   (c) Signs of the trigonometric functions **1**
   (d) Reference angles **1**
   (e) Using reference angles to find other angles **1**, **4**
4. Oblique triangles

   (a) Solving triangles using the law of sines **1**, **2**, **4**
   (b) Solving triangles using the law of cosines **2**, **4**
5. Variation
   (a) Ratios, proportions and their applications **1**, **2**
   (b) Direct variation, inverse variation, applications of variation **2**, **4**
6. Cramer's Rule
   (a) 2×2 and 3×3 determinants
   (b) Solving 2×2 and 3×3 linear systems using Cramer's rule **1**, **4**
7. Complex numbers
   (a) Defining i **1**
   (b) Powers of i
   (c) The rectangular form of complex numbers
   (d) Addition and subtraction of complex numbers **2**
   (e) Multiplication of complex numbers **2**
   (f) Conjugates **2**
   (g) Division of complex numbers **2**
   (h) Using complex numbers to solve quadratic equations **4**

5 Textbook

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

Chapter 2: 2.1, 2.2, 2.4, 2.5 (Include complex solutions to quadratic equations in this section.)
Chapter 5: 5.8
Chapter 7: 7.1 (degrees only), 7.2 (degrees only), 7.3 (degrees only), 7.4 (degrees only)
Chapter 10: 10.1, 10.2
Chapter 11: 11.8

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 $a \neq 0$.

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

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

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

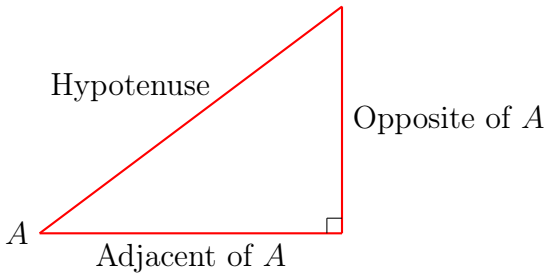
Let d be the distance between (x_1, y_1) and (x_2, y_2).

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

Parallel and Perpendicular Lines

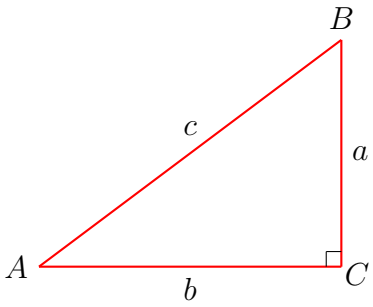
Suppose two lines have slopes m_1 and m_2 respectively. If the lines are parallel, then $m_1 = m_2$. If the lines are perpendicular, then $m_2 = -1/m_1$.

Right Triangle Trigonometry



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

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



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

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

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

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

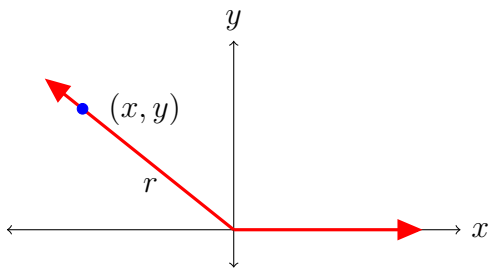
$$\csc(B) = c/b \qquad \sec(B) = c/a \qquad \cot(B) = a/b$$

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

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

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).



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

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

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