Technical Mathematics Course Outlines

Associate Studies Department

August 1, 2010

2030:130 Mathematics for Allied Health

Bulletin Description

2030:130 Mathematics for Allied Health
3 credits
Prerequisite: Placement test.
The real number system, systems of measurement, conversions, linear equations, factoring, quadratic equations, graphing, linear systems, organizing data, averages, standard deviation, the normal distribution.

Assessment Outcomes

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

1. the ability to use basic algebra,
2. the ability to use ratios, proportions, variation to solve real-world problems,
3. a complete understanding of percentages and their uses,
4. an understanding of measurement systems,
5. the ability to convert measurements from one form to another form of measurement,
6. the ability to solve systems of linear equations and to use them in applications,
7. an understanding of the algebra of polynomials up to quadratic equations,
8. the ability to compute and use basic statistics.

Course Outline

1. The Real Numbers
   (a) Fractions, decimals, percentages
   (b) Negative numbers
   (c) Powers and roots
2. Systems of Measurement
   (a) Metric and U.S. systems: length, area, volume, mass, capacity, temperature, time, pressure, velocity
   (b) Reductions and conversions
3. Basic Algebra

(a) Algebraic expressions and operations: symbols and terminology, addition and subtraction of polynomials, multiplication and division of polynomials

(b) Linear equations: finding solutions, formulas, word problems, ratios and proportions, mixture problems, dilution problems, percentages of solution problems, direct and indirect variation

(c) Factoring: removing common factors, differences of squares, trinomials

(d) Quadratic equations: Solving by factoring, using the quadratic formula, applications

4. Graphs

   (a) The rectangular coordinate system

   (b) Graphs of linear equations in two variables

5. Systems of Equations

   (a) Solving a 2×2 system graphically

   (b) Solving a 2×2 system algebraically

   (c) Mixture problems

6. Statistics

   (a) Organizing data: tables, pie charts, bar graphs, etc.

   (b) Mode, median, mean

   (c) Standard deviation

   (d) The normal distribution

Text Coverage

The following sections of *Mathematics for the Health Sciences: A Comprehensive Approach* by Helms should be covered in this course and in order they are listed. As the text does not contain all of the topics that need to be covered in the course, supplementary material from *Technical Mathematics, Second Edition* by Ewen, Gary and Trefzger is also listed. Sections 5.1, 6.2, 6.3, 8.2, and 8.3 of *Mathematics for the Health Sciences* may be consulted for examples and background information.

Ch 1: 1.1, 1.2, 1.3, 1.4, 1.5
Ch 2: 2.1, 2.2
Section 6.1 from *Technical Mathematics*
Ch 2: 2.3, 2.4, 2.5, 2.6, 2.7, 2.8
Sections 5.1, 5.2, 5.3, 7.1, and 7.3 from *Technical Mathematics*
Ch 3: 3.1, 3.2, 3.3, 3.5
Ch 4: 4.1, 4.2, 4.3, 4.4
Ch 5: 5.2, 5.7
Ch 6: 6.1, 6.4, 6.5, 6.6
Ch 9: 9.1, 9.2, 9.3, 9.4
Ch 10: 10.1, 10.2, 10.3, 10.4, 10.5

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.

2030:161 Mathematics for Modern Technology

Bulletin Description

2030:161 Mathematics for Modern Technology
4 credits
Prerequisites: 2010:052 or placement by advisor.
Lines, linear regression, sets, counting, basic probability, basic statistics, binomial and normal distributions, mathematics of finance, symbolic logic, arguments, logic circuits.

Assessment Outcomes

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

1. the ability to graph lines, find equations of lines, and use linear regression lines in applications,
2. an understanding of sets and basic counting techniques and their uses,
3. the ability to compute simple probabilities and odds,
4. the ability to compute and apply modes, medians, means, expected values and standard deviations,
5. an understanding of the binomial and normal distributions and their applications,
6. an understanding of the mathematics of finance including simple interest, compound interest, annuities, present value, future value, the APR, and consumer loans,
7. an understanding of basic symbolic logic, arguments, and logic circuits.

Course Outline

1. Lines
   (a) The concept of slope
   (b) Graphing a line using its slope
   (c) Finding the slope-intercept and general forms of a line
   (d) Finding the slope-intercept form given a general form
   (e) Linear regression and its applications
2. Sets and Counting
   (a) Basic set theory
   (b) The inclusion-exclusion principle
   (c) The multiplication principle
   (d) Permutations
   (e) Combinations
3. Probability
   (a) Probability of an event
   (b) Computing probabilities, applications
   (c) Odds, applications

4. Statistics
    (a) Organizing data
    (b) Averages: mode, mean, median
    (c) Expected value
    (d) Dispersion: variance and standard deviation
    (e) Normal distribution, applications
    (f) Binomial distribution, applications
5. Mathematics of Finance
    (a) Simple and compound interest: compound amount, present value, effective rate
    (b) Ordinary annuities: present value, future value
    (c) The APR, consumer loans
    (d) Difference equations
    (e) Finanacial mathematics using difference equations
6. Logic
    (a) Symbolic logic: statements, and, or, not, implication
    (b) Truth tables
    (c) Logical equivalence
    (d) Arguments, rules of inference
    (e) Logic circuits

Text Coverage

The following sections of *Finite Mathematics & Its Applications, Tenth Edition* by Goldstein, Schneider, and Siegel should be covered in this course:

Chapter 1: 1.1, 1.2, 1.3, 1.4, 1.5
Chapter 5: 5.1, 5.2, 5.3, 5.4, 5.5
Chapter 6: 6.1, 6.2, 6.3, 6.4
Chapter 7: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7
Chapter 10: 10.1, 10.2, 10.3, 10.4
Chapter 11: 11.1, 11.2, 11.4
Chapter 12: 12.1, 12.2, 12.3, 12.4, 12.5, 12.7

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.

2030:151 Technical Mathematics I

Bulletin Description

2030:151 Technical Mathematics I
2 credits
Prerequisites: Placement test.
Fundamental concepts and operations, functions, graphs, factoring and algebraic fractions, variation, and quadratic equations.

Assessment Outcomes

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

1. the ability to solve basic algebra problems,
2. an understanding of functions and their graphs,
3. the ability to use basic factoring techniques,
4. an understanding of fractions with variables,
5. the ability to solve systems of linear equations,
6. the ability to solve quadratic equations.

Course Outline

1. Basic Algebra
   (a) Scientific notation
   (b) Algebraic expressions
   (c) Addition and subtraction of algebraic expressions
   (d) Exponents and radicals
   (e) Multiplication of algebraic expressions
   (f) Division of algebraic expressions
   (g) Linear equations
   (h) Formulas and their applications
2. Functions and Graphs
   (a) Functions and function notation
   (b) Graphing functions and simple algebraic equations
3. Factoring
   (a) Special products: product of two binomials, square of a binomial
   (b) Factoring out a common factor
   (c) Factoring the difference of two squares
   (d) Factoring trinomials
4. Algebraic Fractions

(a) Equivalent fractions
(b) Reducing fractions
(c) Multiplication and division of fractions
(d) Addition and subtraction of fractions
(e) Complex fractions
(f) Equations with fractions

5. Systems of Linear Equations
   (a) Solving a 2×2 linear system by graphing
   (b) Solving a 2×2 linear system by substitution
   (c) Solving a 2×2 linear system by elimination
6. Quadratic Equations
   (a) Solving a quadratic equation by factoring
   (b) Solving a quadratic equation using the quadratic formula

Text Coverage

The following sections of *Technical Mathematics, Second Edition* by Ewen, Gary, and Trefzger should be covered in this course:

Chapter 1: 1.1 (optional), 1.2 (optional), 1.3, 1.4 (optional), 1.5 (optional), 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13 (optional)
Chapter 4: 4.1, 4.2
Chapter 5: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8
Chapter 6: 6.1
Chapter 7: 7.1, 7.2, 7.3

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.

Formula Policy

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

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

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

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

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

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

2030:152 Technical Mathematics II

Bulletin Description

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

Assessment 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.

Course Outline

1. Lines
   (a) The concept of slope
   (b) Graphing a line using its slope
   (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
   (h) Midpoint of a line segment
2. Right-Triangle Trigonometry
   (a) Angles, measuring angles using degrees
   (b) Defining the six trigonometric ratios
   (c) Computing the value of a trigonometric ratio using a calculator
   (d) Using inverse trigonometric functions to find acute angles
   (e) Solving right triangles
   (f) Applications of right-triangle trigonometry
3. Trigonometric Functions
   (a) Angles made by rotation, measuring angles in standard position, coterminal angles

(b) Defining the six trigonometric functions
(c) Signs of the trigonometric functions
(d) Reference angles
(e) Using reference angles to find other angles

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

Text Coverage

The following sections of *Technical Mathematics, Second Edition* by Ewen, Gary, and Trefzger should be covered in this course:

Chapter 1: 1.14, 1.15
Chapter 3: 3.1, 3.2, 3.3, 3.4
Chapter 4: 4.3, 4.4, 4.5
Chapter 6: 6.4, 6.5, 6.6
Chapter 10: 10.1, 10.2
Chapter 11: 11.1, 11.2, 11.3
Chapter 14: 14.1

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.

Formula Policy

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

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

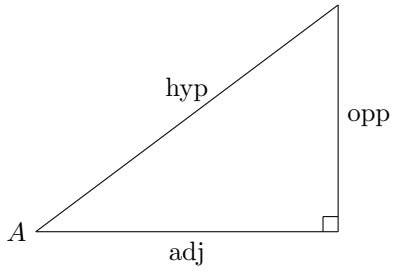
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$y = mx + b$$

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

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

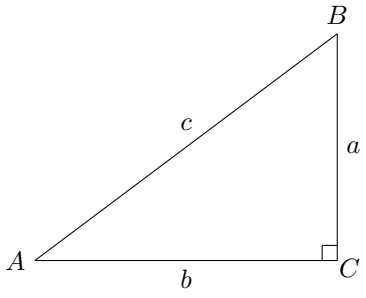
Suppose two lines have slopes m_1 and m_2 respectively. If the lines are parallel, then $m_1 = m_2$. If the lines are perpendicular, then $m_2 = -\frac{1}{m_1}$.



$$\sin(A) = \frac{\text{opposite of } A}{\text{hypotenuse}} \qquad \csc(A) = \frac{1}{\sin(A)}$$

$$\cos(A) = \frac{\text{adjacent of } A}{\text{hypotenuse}} \qquad \sec(A) = \frac{1}{\cos(A)}$$

$$\tan(A) = \frac{\text{opposite of } A}{\text{adjacent of } A} \qquad \cot(A) = \frac{1}{\tan(A)}$$



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

$$\sin(A) = \frac{a}{c} \qquad \cos(A) = \frac{b}{c} \qquad \tan(A) = \frac{a}{b}$$

$$\csc(A) = \frac{c}{a} \qquad \sec(A) = \frac{c}{b} \qquad \cot(A) = \frac{b}{a}$$

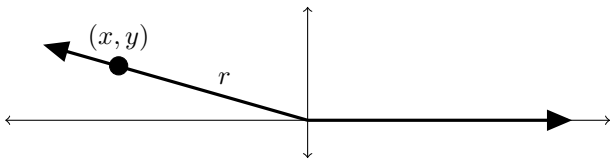
$$\sin(B) = \frac{b}{c} \qquad \cos(B) = \frac{a}{c} \qquad \tan(B) = \frac{b}{a}$$

$$\csc(B) = \frac{c}{b} \qquad \sec(B) = \frac{c}{a} \qquad \cot(B) = \frac{a}{b}$$

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

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

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



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

$$\sin(\theta) = \frac{y}{r} \qquad \csc(\theta) = \frac{r}{y}$$

$$\cos(\theta) = \frac{x}{r} \qquad \sec(\theta) = \frac{r}{x}$$

$$\tan(\theta) = \frac{y}{x} \qquad \cot(\theta) = \frac{x}{y}$$

2030:153 Technical Mathematics III

Bulletin Description

2030:153 Technical Mathematics III
2 credits
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.

Assessment 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,

Course Outline

1. Factoring
   (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

   (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

4. Functions

   (a) Definition of a function, function notation, types of functions

   (b) Evaluation of a function

   (c) The domain and range of a function expressed using inequality and interval notations

   (d) Graphs of functions

   (e) The relationship between a function and its graph (obtaining information from or about the graph of a function)

   (f) Operations on functions (addition, subtraction, multiplication, division)

5. Exponentials and Logarithms

   (a) The exponential function

   (b) The logarithm

   (c) Properties of logarithms

   (d) Common logarithms

   (e) Natural logarithms

   (f) Solving exponential equations

   (g) Solving logarithmic equations

6. Trigonometric Functions

   (a) Radian measure of angles

   (b) Applications of radian measure

7. (Optional) Progressions and the Binomial Theorem

   (a) Arithmetic progressions

   (b) Geometric progressions

   (c) The binomial theorem

Text Coverage

The following sections of *Technical Mathematics, Second Edition* by Ewen, Gary, and Trefzger should be covered in this course:

Chapter 1: 1.8, 1.9
Chapter 4: 4.1, 4.2 (Supplemental material is needed)
Chapter 5: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6
Chapter 8: 8.1, 8.2, 8.6, 8.7 (Include complex solutions to quadratic equations in this section.)
Chapter 9: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7
Chapter 10: 10.3, 10.4
Chapter 18: 18.1 (optional), 18.2 (optional), 18.3 (optional)

The following order of topics should be followed in Technical Mathematics III: Chapters 10, 1, 4, 5, 8, 9, 18.

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.

Formula Policy

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

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

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

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

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

$180^\circ = \pi$ 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.

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

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

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

$\log_b\left(m^n\right) = n\log_b(m)$ $(m > 0)$

$\log_b(b) = 1$ $\qquad$ $\log_b(1) = 0$

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

2030:154 Technical Mathematics IV

Bulletin Description

2030:154 Technical Mathematics IV
3 credits
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.

Assessment Outcomes

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.

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

Text Coverage

The following sections of *Technical Mathematics, Second Edition* by Ewen, Gary, and Trefzger should be covered in this course:

Chapter 4: 4.2
Chapter 5: 5.7
Chapter 8: 8.1, 8.2, 8.3
Chapter 12: 12.1, 12.2, 12.3, 12.4, 12.5
Chapter 13: 13.1, 13.2, 13.3, 13.4, 13.5

Chapter 14: 14.2, 14.3, 14.4
Chapter 16: 16.1, 16.2, 16.3
Chapter 20: 20.1, 20.2 (optional), 20.3 (optional), 20.4 (optional), 20.5, 20.6

Graphing trigonometric functions (Chapter 12) should be covered at the beginning of the course. Difference quotients, piecewise defined functions, operations on functions, composition of functions, rational functions, and vertical and horizontal asymptotes are not included in current textbook and should be covered using supplemental materials.

Calculator Policy

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. No exceptions to this policy will be made by the instructor.

Formula Policy

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

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

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

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

Fundamental Trigonometric Identities

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

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

2030:255 Technical Calculus I

Bulletin Description

2030:255 Technical Calculus I
3 credits
Prerequisites: 2030:154 or equivalent with a grade of C− or better, or placement test.
The derivative, applications of the derivative, derivatives of the trigonometric, logarithmic, and exponential functions, integration by antidifferentiation.

Assessment Outcomes

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

1. the ability to calculate limits of functions,
2. the ability to identify the derivative as a particular kind of limit,
3. the ability to find the derivative of a function,
4. the ability to sketch the graph of a real-valued function by using derivatives,

5. the ability to recognize and solve technical problems by using differential calculus,
6. the ability to find the integral of a function.

Course Outline

1. The Derivative
   (a) Motion
   (b) Tangent lines
   (c) Definition of the derivative
   (d) Differentiation of polynomials
   (e) The product and quotient rules
   (f) The power rule
   (g) Implicit differentiation
   (h) Higher derivatives
2. Applications of the Derivative
   (a) Curve sketching
      - Relative extreme points
      - Concavity and inflection points
   (b) Optimization
   (c) Related rates
   (d) Differentials
3. Derivatives of Special Functions
   (a) Trigonometric functions
   (b) Inverse trigonometric functions
   (c) Exponential functions
   (d) Logarithmic functions
   (e) Logarithmic differentiation
4. Integration
   (a) Indefinite integrals
   (b) Applications of indefinite integrals
   (c) Definite integrals
   (d) Area under a curve
   (e) Integration by substitution
   (f) Exponential and logarithmic forms
   (g) Trigonometric forms
   (h) Inverse trigonometric forms

Text Coverage

The following sections of *Technical Calculus, Fifth Edition* by Ewen, Gary, and Trefzger should be covered in this course:

Chapter 2: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.10
Chapter 3: 3.1, 3.2, 3.3, 3.5, 3.6, 3.7
Chapter 4: 4.1 (optional), 4.2, 4.3, 4.4 (optional), 4.5, 4.6 (optional), 4.7, 4.8, 4.10
Chapter 5: 5.1, 5.2, 5.3, 5.4
Chapter 7: 7.1, 7.2, 7.3, 7.4, 7.5

Calculator Policy

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. No exceptions to this policy will be made by the instructor.

Formula Policy

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

$$\frac{d}{dx}(u^n) = n\,u^{n-1}\frac{du}{dx} \qquad \frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx} \qquad \frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

$$\frac{d}{dx}(\sin(u)) = \cos(u)\,\frac{du}{dx} \qquad \frac{d}{dx}(\cos(u)) = -\sin(u)\,\frac{du}{dx} \qquad \frac{d}{dx}(\tan(u)) = \sec^2(u)\,\frac{du}{dx}$$

$$\frac{d}{dx}(\sec(u)) = \sec(u)\,\tan(u)\,\frac{du}{dx} \qquad \frac{d}{dx}(\csc(u)) = -\csc(u)\,\cot(u)\,\frac{du}{dx} \qquad \frac{d}{dx}(\cot(u)) = -\csc^2(u)\,\frac{du}{dx}$$

$$\frac{d}{dx}(\sin^{-1}(u)) = \frac{1}{\sqrt{1-u^2}}\,\frac{du}{dx} \qquad \frac{d}{dx}(\cos^{-1}(u)) = -\frac{1}{\sqrt{1-u^2}}\,\frac{du}{dx} \qquad \frac{d}{dx}(\tan^{-1}(u)) = \frac{1}{1+u^2}\,\frac{du}{dx}$$

$$\frac{d}{dx}(\ln(u)) = \frac{1}{u}\,\frac{du}{dx} \qquad \frac{d}{dx}\left(e^u\right) = e^u\,\frac{du}{dx}$$

$$\int u^n\,du = \frac{u^{n+1}}{n+1} + C \quad (n \neq -1) \qquad \int \frac{1}{u}\,du = \ln|u| + C \qquad \int e^u\,du = e^u + C$$

$$\int \sin(u)\,du = -\cos(u) + C \qquad \int \cos(u)\,du = \sin(u) + C \qquad \int \sec^2(u)\,du = \tan(u) + C$$

$$\int \csc^2(u)\,du = -\cot(u) + C \qquad \int \sec(u)\,\tan(u)\,du = \sec(u) + C \qquad \int \csc(u)\,\cot(u)\,du = -\csc(u) + C$$

$$\int \tan(u)\,du = -\ln|\cos(u)| + C \qquad \int \cot(u)\,du = \ln|\sin(u)| + C \qquad \int \sec(u)\,du = \ln|\sec(u) + \tan(u)| + C$$

$$\int \csc(u)\,du = \ln|\csc(u) - \cot(u)| + C$$

2030:356 Technical Calculus II

Bulletin Description

2030:356 Technical Calculus II
3 credits
Prerequisites: 2030:255 or equivalent with a grade of C− or better, or placement test.
Methods and applications of integration, first and second order differential equations, series expansion, Laplace transforms, partial derivatives, and double integrals.

Assessment Outcomes

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

1. the ability to find the integral of a function by using partial fractions, integration by parts, or trigonometric substitution,
2. the ability to find areas and volumes by integration,
3. the ability to find the solutions of first-order differential equations using separation of variables or integrating factors,
4. the ability to solve second-order differential equations using standard methods and Laplace transforms,
5. the ability to use differential equations when solving real-world problems,
6. an understanding of the properties of numerical series and series of functions.

Course Outline

1. Applications of Integration
   (a) Area between curves
   (b) Volumes of revolution — disk method
   (c) Volumes of revolution — shell method
   (d) Center of mass
2. Methods of Integration
   (a) Partial fractions
   (b) Integration by parts
   (c) Trigonometric substitution
   (d) Integration using tables
   (e) Numerical methods
3. First-Order Differential Equations
   (a) Solutions of differential equations
   (b) Separation of variables
   (c) Integrating factors
   (d) First-order linear equations
   (e) Applications

4. Second-Order Differential Equations
    (a) Linear homogeneous case
    (b) Linear nonhomogeneous case
    (c) Applications
    (d) Laplace transforms
    (e) Using Laplace transforms
5. Series
    (a) Convergence
    (b) Convergence tests
    (c) Power series
    (d) Maclaurin and Taylor series
    (e) Approximating series
    (f) Fourier series

Text Coverage

The following sections of *Technical Calculus, Fifth Edition* by Ewen, Gary, and Trefzger should be covered in this course:

Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6 (optional), 6.7 (optional)
Chapter 7: 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 7.13
Chapter 11: 11.1, 11.2, 11.3, 11.4, 11.5
Chapter 12: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6
Chapter 10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.9
There may not be enough time to cover chapter 10. If there is time, the most important sections are 10.5 and 10.9.

Calculator Policy

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2030:345 Technical Data Analysis

Bulletin Description

2030:345 Technical Data Analysis
2 credits
Prerequisites: 2030:154 or equivalent with a grade of C− or better, or placement test.
Data summarization including graphing presentation, numerical measures, introduction to probability, confidence intervals, and hypothesis testing.

Assessment Outcomes

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

1. an understanding of the nature of data sets,
2. an understanding of the process of designing of a statistical study,
3. an understanding of the importance of using different methods of collecting data sets,
4. the ability to summarize data based on the methods of descriptive statistics: graphing presentation and numerical measures (measures of central tendency, measures of variation, measures of position),
5. the ability to use the counting techniques (multiplication principle, permutations, combinations),
6. the ability to compute probabilities, odds, and expected values,
7. an understanding of the normal distribution and its applications,
8. the ability to compute confidence intervals,
9. the ability to do hypothesis testing,
10. the ability to apply all of the above to real-life projects,
11. the ability to use technology such as the graphing calculator and spreadsheet software.

Course Outline

1. Introduction to Statistics
   (a) The nature of data
   (b) Uses and abuses of statistics
   (c) Design of experiments
2. Describing, Exploring, and Comparing Data
   (a) Summarizing data with frequency tables
   (b) Pictures of data
   (c) Measures of central tendency
   (d) Measures of variation
   (e) Measures of position
   (f) Exploratory data analysis
3. Correlation and Regression
   (a) Linear regression
   (b) Correlation
4. Probability
   (a) Counting
   (b) Fundamentals
5. Probability Distributions

(a) Random variables
(b) Binomial probability distributions
(c) The Normal Distribution
(d) The Central Limit Theorem
(e) Approximating a binomial distribution
(f) Determining normality

6. Estimates and Sample Sizes
   (a) Estimating population means
   (b) Determining sample size
   (c) Estimating population proportions
7. Hypothesis Testing

Text Coverage

The following sections of *Elementary Statistics, Tenth Edition* by Triola should be covered in this course:

Chapter 1: 1.1, 1.2, 1.3, 1.4
Chapter 2: 2.1, 2.2, 2.3, 2.4
Chapter 3: 3.1, 3.2, 3.3, 3.4, 3.5
Chapter 4: 4.1, 4.2, 4.7
Chapter 5: 5.1, 5.2
Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.5
Chapter 7: 7.1, 7.2, 7.3, 7.4
Chapter 10: 10.1, 10.2, 10.3

Calculator Policy

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. No exceptions to this policy will be made by the instructor.

2030:260 Advanced Trigonometry

Bulletin Description

2030:260 Advanced Trigonometry
2 credits
Prerequisites: 2030:153 or equivalent with a grade of C− or better, or placement test.
Horizontal circular curves, vertical curves, and spherical triangles, topics in astronomy.

Assessment Outcomes

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

1. the ability to identify a tangent line, secant line, diameter, radius, and chord of a circle,
2. the ability to find the length of an arc and a chord of a circle,
3. the ability to find the area of a sector, a segment, and between tangent lines and the circle,

4. the ability to determine the slope and external distance of a vertical curve,
5. the ability to identify the interior and dihedral angles in a spherical triangle,
6. an understanding of spherical coordinates,
7. the ability to use sine and cosine formulas for spherical triangles to solve theoretical and real-world applications,
8. an understanding of the PZS triangle and its applications.

Course Outline

1. Circles and Circular Curves
   (a) Arcs and central angles
   (b) Chords and segments
   (c) Secant and tangent lines
   (d) Perpendicular bisectors
   (e) Lengths of tangent lines, chords, curves, external distances and middle ordinates
   (f) Circular curve computation
2. Parabolic Curves
   (a) Slope of a line (grade or gradient)
   (b) Distance of a line
   (c) Points of vertical curvature, intersection, and tangency
   (d) Tangent elevations
   (e) Basic form of a parabola
   (f) Finding the external distance of a vertical curve
3. Spherical Trigonometry
   (a) Spherical triangles
   (b) Interior angles
   (c) Dihedral angles
   (d) Sine formulas for spherical triangles
   (e) Cosine formulas for sides of spherical triangles
   (f) Cosine formulas for angles of spherical triangles
4. Astronomy
   (a) Astronomical definitions
   (b) The PZS triangle
   (c) Applications of the PZS triangle
   (d) Sources of error in astronomical observations

Text Coverage

For circles, circular and parabolic curves use the following sections of the *Land Surveyor Reference Manual, Third Edition* by Harbin (2006).

Chapter 2: 2-31, 2-32, 2-33, 2-34, 2-35, 2-36, 2-37, 2-38, 2-39, 2-40, 2-41, 2-42, 2-43, 2-44, 2-45
Chapter 17: 17-1, 17-2, 17-3, 17-4, 17-5, 17-6, 17-7, 17-8, 17-9, 17-10, 17-14, 17-16
Chapter 22: 22-1, 22-2, 22-3, 22-4, 22-5, 22-6

For spherical trigonometry use the provided supplemental material or *Sphere, Spheroid and Projections for Surveyors* by Jackson (1987).

Chapter 2: 2.1, 2.2, 2.3, 2.4
Chapter 3: 3.1, 3.2

Calculator Policy

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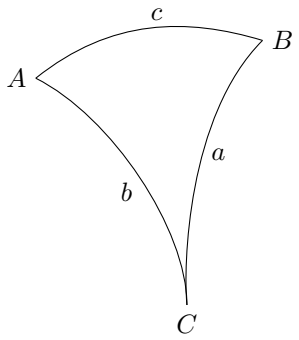
Formula Policy

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



$$\frac{\sin(a)}{\sin(A)} = \frac{\sin(b)}{\sin(B)} = \frac{\sin(c)}{\sin(C)}$$

$$\cos(a) = \cos(b)\cos(c) + \sin(b)\sin(c)\cos(A)$$

$$A = 4\pi r^2$$

$$V = \frac{4}{3}\pi r^3$$

2030:480 Advanced Topics in Technical Mathematics

Bulletin Description

2030:480 Advanced Topics in Technical Mathematics
2 credits
Prerequisites: 2030:255 or equivalent with a grade of C− or better, or placement test.
Matrices, introduction to series, partial derivatives, least squares adjustments, and coordinate systems.

Assessment Outcomes

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

1. the ability to perform matrix addition, scalar multiplication of matrices, transposing of matrices, and matrix multiplication,

2. the ability to find the solution of a linear system of equations using matrices,
3. an understanding of power series,
4. the ability to find the partial derivative of a function,
5. the ability to recognize and solve technical problems by using partial derivatives,
6. the ability to calculate the least squares adjustment using the observed equation and matrix methods,
7. an understanding of polar, spherical, geocentric and geodetic coordinate systems and position computation.

Course Outline

1. Matrices
   (a) Basic operations on matrices
   (b) Multiplication of matrices
   (c) The inverse of a matrix
   (d) The transpose of a matrix
   (e) Solving a system of linear equations using matrices
2. Series
   (a) Introduction to series
   (b) Power series
3. Partial Derivatives
   (a) Power rule
   (b) Product rule
   (c) Chain rule
   (d) Partial derivatives
   (e) Applications of partial derivatives
4. Least Squares Adjustments
   (a) Introduction to least squares adjustments
   (b) Conditions for least squares
   (c) Observation equation method
   (d) Matrix methods in least squares adjustments
5. Coordinate Systems
   (a) The polar coordinate system
   (b) The spherical coordinate system
   (c) The geocentric and geodetic coordinate systems
   (d) The local geodetic coordinate system
   (e) Ellipsoidal radii of curvature

Text Coverage

Supplemental material is used for this course.

The course 2980:310, Survey Computations and Adjustments has Topics in Advanced Mathematics as a corequisite. In order to ensure that students taking these two courses during a single semester have learned the mathematics they need for Survey Computations and Adjustments, the order of the supplemental material should be followed in Advanced Topics in Technical Mathematics.

Calculator Policy

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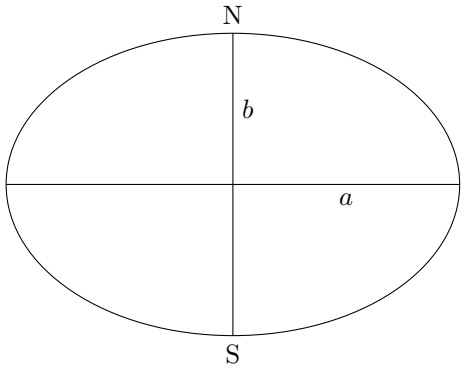
Formula Policy

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



a = semi-major axis

b = semi-minor axis

ϕ = latitude

$$f = \frac{a-b}{a}$$

$$e^2 = \frac{a^2 - b^2}{a^2}$$

$$M = \frac{a\left(1-e^2\right)}{\left(1-e^2\sin(\phi)\right)^{3/2}}$$

$$N = \frac{a}{\sqrt{1-e^2\sin^2(\phi)}}$$

Mathematics Area Assessment Outcomes

After completing the mathematics component of their general education, Summit College students should possess the following competencies:

1. the ability to use algebraic tools when making qualitative and quantitative judgements,
2. the ability to recognize and solve technical problems using mathematical techniques,
3. the ability to recognize and use of a wide range of mathematical applications,
4. the ability to construct and interpret the various types of graphs,
5. an understanding the mathematical function concept and its applications,
6. the ability to use common technological tools when when solving mathematical problems,
7. the ability to utilize critical thinking and analytical skills when solving real-life problems,
8. knowledge of the effects of mathematics on human activities and society.

Technical Mathematics Certificate

Bulletin Description

This certificate, requiring a minimum of 11 credit hours, is aimed at developing technical mathematics knowledge and the ability to apply this knowledge in an industrial setting. At least 6 of the 11 credit hours must be taken through Summit College with a grade point average of 2.5. The granting of this certificate does not require the completion of a degree. Students are required to take the following courses or equivalent for completion of the program.

2030:154 Technical Mathematics IV (3 credits)
2030:255 Technical Calculus I (3 credits)

2030:356 Technical Calculus II (3 credits)
OR
2030:480 Advanced Topics in Technical Mathematics (2 credits)

At least 2 credit hours must be taken as electives from the following courses:
2030:260 Advanced Trigonometry (2 credits)
2030:345 Technical Data Analysis (2 credits)
2030:480 Advanced Topics in Technical Mathematics (2 credits)
2030:290 Special Topics (1-4 credits)
A 3450:200/300/400 level mathematics course approved by the Technical Mathematics faculty of the Associate Studies Department.