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Overview:

This course is designed to provide students with mathematical concepts and skills that are essential to an understanding of their selected major. Through an emphasis on conceptual understanding, students will learn how to construct and solve functional models from verbal descriptions and real data. The course will be organized around 5 units:

Unit #1: Functions, graphing, linear functions, linear systems, matrices

Unit #2: Function operations/transformations; piecewise, inverse, exponential, and logarithmic functions

Unit #3: Polynomial and rational functions; zeros, extrema, concavity, inflection points, asymptotes, slope of tangent lines

Unit #4: Trigonometric Functions, unit circle, identities, radians, sinusoidal functions

Unit #5: Applying functions to model real data

The concepts and methods covered in this course will be applied to examples of problems in the fields of business, the natural sciences, and the social sciences. Students can use graphing calculators in class and on exams, but students without graphing calculators will not be disadvantaged on the exams.

Required Materials:

College Algebra (7th ed.) by Michael Sullivan (ISBN: X-XXX-XXXXX-X)
Binder or notebook for course notes and homework

Prerequisites:

Students enrolled in this course have successfully completed the equivalent of Intermediate Algebra (via the MATH 095 course here at SAU, equivalent high school course work, or appropriate score on the placement exam). Students are assumed to be comfortable with basic algebraic manipulations and concepts. If necessary, we will review fundamental algebraic concepts as we introduce new topics. No previous experience with graphing calculators is necessary.

Course Procedures:

This course will focus primarily on the application of mathematical concepts (yes, that means you should expect story problems). We will begin each unit by examining data from a realistic situation (radioactive decay, population growth, revenues/expenses, changes in tuition costs). We will then learn how to model these situations through a set of functions (along with important concepts and definitions within each function). After we have modeled the situation, we will learn important concepts and methods we can use to solve problems. Through question-and-answer sessions and guided problem solving, we will apply our modeling skills and concepts to other problems.

Most of the problems in this course can be solved through a variety of graphical and analytic approaches. In order to check for your understanding, I will occasionally ask small groups of students to solve problems in front of the class. These problems may come from previous homework assignments or may be new problems. The purpose of this is not to embarrass you – I want you to gain experience solving problems and explaining your solutions. I encourage students to work together on homework assignments and share class notes, but make sure you are able to solve problems on your own.

Before each class period, I recommend you quickly read the corresponding section from your textbook. This will enable you to get more out of each class period. During class, I ask that you take notes and actively participate (ask and answer questions). After class, you should solve all the assigned homework problems. The assigned homework problems are odds, so you will be able to immediately check your answer after attempting each problem. If you cannot solve a homework problem, we can work together to solve it in class (or during my office hours). Feel free to work with other students on the assigned homework, but make sure you write out your own answers. Homework for the entire unit will be collected on the day of the test.

After completing each unit, students will take a test to demonstrate their understanding of the content. While test questions will not look identical to the homework problems, you will only be tested over material covered in class. If I did not teach a concept in class, it will not be tested. Students will be allowed to use 1 page of handwritten notes on each unit exam. Because homework items differ from the test items, I will give credit to students who complete the homework in each unit. Students not completing the homework will not be penalized.

All students are expected to:

- Attend Class. My tests questions sample content we covered in class. If you are not in class, you will not perform well on the exams. Also, I occasionally offer students opportunity for extra points in class. If you miss class, you are not eligible for these points. If you must miss class, I'd appreciate it if you let me know In advance.
- Actively Participate in Class Discussions. The students who perform the best in this class are typically the students who ask and answer questions in class. Attempting to answer questions in class will help you determine if you are learning the material covered in class.
- Successfully Complete All Quizzes, Tests, and Classroom Activities. I may occasionally quiz students at the beginning of class. These quizzes will check your knowledge of basic concepts and skills that I believe all students should have learned. The unit exams will check your understanding of more advanced concepts/skills and will test your ability to apply these skills to new situations. Students will be allowed to use one page of handwritten notes on the exams. Students absent on the day of an exam must notify me beforehand. If you miss a test due to an unexcused absence, you will receive a grade no higher than a C when you take the make-up exam.
- Take Responsibility For Their Learning. If you were confused in class or feel as though you did not learn the material, let me know – visit my office, send me an e-mail, or call me. If you need to meet outside my posted office hours, just let me know. Or, if you'd prefer, you can receive additional assistance from the tutors at the Student Success Center. Do not wait until the day before the test to ask for help!

Student Evaluation:

Each unit in this course will be worth the same amount of points. Each unit grade will be based on:

	Traditional	No Homework
Homework Portfolios (solutions and work shown)	10%	0%
Quizzes, in-class activities, Participation	10%	10%
Unit Exam	80%	90%

You should expect the following grading scale: 90 -- 100% A
80 -- 89% B
70 -- 79% C
60 -- 69% D
0 - 59% F

The actual grading scale used to assign grades will depend on the exams I create for each unit (if I write more difficult tests, the grading scale **may** drop a bit)

Plagiarism:

Don't cheat. You can work with other students on the homework, but the exams should only represent your level of understanding. Review the Policy on Academic Dishonesty in the University Catalog.

Accommodations:

Students with disabilities who believe they may need accommodations in this class are encouraged to contact the Office of Services for Students with Disabilities at 333-6275 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

MATH 151 Course Objectives: The exams will test your ability to do the following:

Unit #1: Functions / Linear Functions

Functions and Graphing

- Functions
 - Define *function*
 - Determine if a situation represents a functional relationship
 - Identify independent and dependent variables
 - Express functions using (1) words, (2) graphs/scatterplots, (3) tables, (4) formulas
 - Express functions using function notation
 - Evaluate functions for given values of the independent variable
 - Define the domain and range of a function; identify the domain and range of a function
- Graphing
 - Plot points on the Cartesian coordinate system
 - Derive the distance formula and use it to find the distance between points
 - Find the midpoint of a line segment
 - Explain why the Vertical Line Test determines if a graph represents a function

Linear Functions

- Define *linear function*
- Find the formula for a linear function
 - Write the formula for a linear function in slope-intercept form
 - Find the x- and y-intercepts of a linear function
 - Interpret the intercepts in an application
 - Calculate the slope of a line (also for vertical and horizontal lines)
 - Interpret the slope of a line in an application
 - Write the formula for a linear function in point-slope form
 - Given 2 points, a point and the slope, or both intercepts
 - Find the formula for a line parallel to a given line
 - Find the formula for a line perpendicular to a given line
- Graph linear functions by hand & with calculator

Linear Equations, Inequalities, and Applications

- Solve linear equations and inequalities analytically
- Solve equations and inequalities graphically (intersection of graphs method)
- Model situations using linear functions (determine the appropriateness of using a linear function to model a situation)
- Interpret the slope and intercepts from an application
- Interpret the point of intersection in an application

Systems of linear equations

- Solve a system of linear equations using the substitution method
- Solve a system of linear equations using the elimination method
- Solve a system of linear equations by row transformation

Matrices

- Add/subtract matrices; multiply a matrix by a scalar
- Multiply matrices (identify when matrices can be multiplied)
- Identify the order of a matrix

Unit #2: Function Operations / Inverse Functions / Exponential Functions / Logarithms

Graphs of Functions

- Identify vertical and horizontal shifts, reflections, and stretches of graphs based on modifications to their formulas
- Graph modified functions (given a “base” function)

Piecewise Functions / Absolute Values

- Identify the range of an absolute value function
- Given the graph of a function, graph its absolute value
- Solve absolute value equations and inequalities
- Identify the domain and range of a piecewise function
- Determine the formula for a piecewise function given its graph

Function Operations

- Find sum, difference, product, and quotient functions
- Explain *composition of functions*
- Find the composition of functions
- Compose functions using a table or graph

Inverse Functions

- Explain the concept of *inverse functions* (relationship between domain and range)
- Explain what is meant by *one-to-one*
- Explain how the horizontal line test determines if a function is one-to-one
- Find the inverse of a function
- Given the graph of a function, graph its inverse

Exponential Functions

- Explain the a , r , and t parameters of the exponential function: $f(t) = a(1 + r)^t$
- Given the graph of a “base” exponential function, graph changes to the a and r parameters
- Identify situations where exponential functions would be appropriate (constant percentage growth)
- Explain the difference between linear and exponential models
- Use exponential functions to model situations
 - Find and interpret the initial value
 - Find and interpret the rate
- Model applications using: $f(x) = Ne^{kt}$

Logarithmic Functions

- Explain what a logarithm is
- Identify the domain and range of logarithmic functions
- Evaluate simple base 10 logarithms by hand
- Solve exponential equations using logarithms
- Simplify logarithmic functions using properties of logarithms
- Use natural logs to solve exponential equations
- Use the exponential to solve logarithmic equations
- Use the change of base rule

Applications

- Model situations using exponential functions
- Use logarithms to solve applications involving exponential functions
- Model a situation using both linear and exponential functions
- Determine if a linear or exponential function is the more appropriate model
- Use the logistic function to model an application: $f(x) = \frac{k}{1 + be^{-cX}}$

Unit #3: Polynomial & Rational Functions

Quadratic Functions

- Explain what the parameters a, h, k represent in the vertex form of a quadratic function: $q(x) = a(x - h)^2 + k$
- Given a “base” quadratic function, graph modifications to the a, h, and k parameters
- Given the vertex and a point on its graph, find the formula for a quadratic function
- Explain the *zeros* of a quadratic function
- Find the zeros of a quadratic function (1) graphically, (2) using the quadratic formula, and (3) by factoring
- Solve quadratic inequalities
- Identify the domain and range of a quadratic function
- Complete the square to locate the maximum/minimum of a quadratic function
- Find the zeros and max/min of a quadratic function using a graphing calculator
- Explain the imaginary number i
- Simplify complex numbers

Polynomial Functions

- Identify the degree of a polynomial
- Determine the following (based on the formula, a graph, or even/odd degree):

Domain	Range	End behavior	Concavity	Inflection Points	Zeros	Extrema
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- Given the zeros and degree of a polynomial, find the formula for the polynomial function
- Explain the Intermediate Value Theorem
- Explain the Fundamental Theorem of Algebra
- Polynomial division

Rational Functions

- Explain what a rational function is
- Identify the domain and range of a rational function
- Define horizontal and vertical asymptotes (using the concept of limits)
- Find the horizontal and vertical asymptotes of rational functions
- Solve rational equations (common denominator)

Applications

- Use quadratic functions to optimize an application
- Model situations with polynomials; locate and interpret relative extrema
- Solve joint variation problems using rational functions

Unit #4: Trigonometric Functions

Unit Circle

- Use periodic functions to model situations
- Locate angles on a unit circle
- Evaluate trig functions of simple angles by hand
- Find the coordinates of a point along the unit circle given the sine or cosine of an angle
- Explain what a radian is
- Convert radians to degrees and degrees to radians

Trigonometric Functions

- Complete, by hand, a table of trigonometric values for angles ranging from 0 to 360 (at 15-degree intervals)
- Identify over what intervals the tangent function is positive or negative
- Identify the reciprocal relationship between sine/cosecant, cosine/secant, tangent/cotangent
- Evaluate the value of the tangent given the sine and cosine of an angle
- Derive three identities: $\sin^2 x + \cos^2 x = 1$, $\tan^2 x + 1 = \sec^2 x$, $1 + \cot^2 x = \csc^2 x$
- Given the value of a trig function and the quadrant of an angle, evaluate the other trig functions
- Identify the domain and range of the trigonometric functions
- Graph the trigonometric functions (sine and cosine by hand)
- Evaluate the trig functions on a calculator

Sinusoidal Functions

- Explain what the parameters a, b, h, k represent in the sinusoidal function: $f(x) = a\sin b(x - h) + k$
- Identify the amplitude, period, and midline of sinusoidal functions from a graph or the formula
- Use sinusoidal functions to model situations (calculate amplitude, period)

Inverse Trigonometric Functions

- Solve trigonometric equations using inverse trig functions
- Explain the domain and range of the inverse trig functions
- Evaluate the inverse trig functions on a calculator

Unit #5: Mathematical Modeling

Fitting exact and best models

- Fit models graphically by hand (scatterplots)
- Explain the least squares criterion for finding the best fitting line
- Interpret the coefficient of determination
- Interpret the slope and y-intercept of an OLS regression line
- Determine the appropriateness of a linear model
- Calculate the sum of squared errors
- Use an OLS regression line for prediction
- Explain the problems with extrapolation
- Use a calculator to fit nonlinear models
- Judge whether a linear, exponential, or logistic model is most appropriate to model a situation

Sequences & Series

Probability & Counting Methods

Monday		Wednesday		Friday	
8/28	Syllabus & Course Overview • Purchase course materials • Read R.1 – R.2	8/30	Chapter 1-2 Review Groups Solve Problems • Read 3.1, 3.2, 3.3	9/1	Functions • 3.1: 5, 15, 17, 23, 27, 37, 49, 51, 57, 59, 89 • 3.2: 9, 17, 21, 25, 31 • 3.3: 15, 17
9/4	Labor Day – No Class	9/6	Graphing Functions / Distance Formula • 2.1: 17, 23, 29, 39, 43, 61 • 2.2: 39, 41	9/8	Linear Functions • 2.4: 9, 13, 17, 19, 21, 35, 37, 41, 45, 53, 75, 79 • 2.5: 7, 19, 23, 37
9/11	Linear Equations, Inequalities, and Applications • 1.1: 39, 49, 59, 87, 93 • 1.5: 55, 63, 81, 107, 113 • 1.7: 31, 33	9/13	Systems of linear equations • 7.1: 7, 11, 19, 29, 43, 47, 51, 57 • 7.2: 13, 21, 31, 49, 55	9/15	Systems of linear equations - Matrices • 7.3: 17, 25, 37
9/18	Solve problems in class	9/20	Matrix Algebra • 7.4: 7, 9, 13, 17, 23, 25	9/22	Review for Exam #1 Complete all assigned homework
9/25	Exam #1a: Linear Functions Homework Portfolios Due	9/27	Exam #1b: Linear Functions Homework Portfolios Due	9/29	Review exam results
10/2	Absolute value & Piecewise functions • 1.6: 9, 17, 23 • 3.4: 29, 33, 41, 43, 55	10/4	Function operations; compositions; inverse Functions • 5.1: 7, 11, 13, 15, 57, 59 • 5.2: 27, 29, 33, 37, 53, 57, 71	10/6	Exponential Functions • 5.3: 29-36, 53, 55, 61, 75, 79, 81, 83
10/9	Logarithmic Functions • 5.4: 45, 51, 91, 97, 103, 105, 113, 115 • 5.5: 79, 83	10/11	Applications of Exponential/Logs • 5.6: 11, 15, 19, 29, 51 • 5.8: 1, 3, 5, 7, 9, 13, 21	10/13	Work on assigned problems in class
10/16	Review for Exam #2 Complete all assigned homework	10/18	Exam #2: Inverse, Exponential, Logs Homework Portfolios Due	10/20	Midterm Break – No Class
10/23	Review exam results Quadratic Functions • 4.1: 11-18, 45, 53, 55, 69, 77, 79	10/25	Quadratic Equations & Complex Numbers • 1.2: 101	10/27	Solve quadratic problems in class
10/30	Polynomial Functions • 4.2: 37, 39, 45, 46, 59, 65, 69, 81, 99	11/1	Solve polynomial problems in class • Page 387: 115, 120	11/3	Rational Functions • 4.3: 13, 19, 21, 23, 41, 43, 45, 54 • 4.4: 45, 49, 53
11/6	Solve rational functions in class	11/8	Joint Variation Problems • 2.7: 9, 13, 25, 29, 33, 35	11/10	Review for Exam #3
11/13	Exam #3: Polynomial/Rational Homework Portfolios Due	11/15	Review exam results Periodic Functions & the Unit Circle Degrees and Radians • Exercises handed out in class	11/17	Sinusoidal Functions Other Trigonometric Functions and Trig Identities • Exercises handed out in class
11/20	In-class activity	11/22	Thanksgiving Break – No Class	11/24	Thanksgiving Break – No Class
11/27	Inverse Trigonometric Functions & Solving Trigonometric Equations • Exercises handed out in class	11/29	Modeling and solving trigonometric functions	12/1	Review for Exam #4
12/4	Exam #4: Trigonometry Homework Portfolios Due	12/6	Review for final exam	12/8	Review for final exam