MAT 125 Precalculus

Department of Mathematics and Statistics
College of Engineering, Forestry, and Natural Sciences
Northern Arizona University

Semesters Offered: All Credit Hours: 4

Course Description:
MAT 125 Precalculus Mathematics (4). The concept of function; graphs; absolute value, linear, polynomial, rational, exponential, logarithmic and trigonometric functions; systems of equations; analytic geometry. Prerequisite placement. A student with credit in any of the previous courses MAT 112, MAT 120 or MAT 135 may not earn credit in MAT 125.

MAT 125 typically holds four fifty-minute lecture-discussion sessions each week of a standard semester. It is designed to provide a foundation in functions, graphs, and trigonometry sufficient for applications and study of calculus. This involves general properties and analysis of functions; combinations of functions; use of formulas, graphs and tables to present functions; specific types of functions, especially absolute value, polynomial, rational, exponential, logarithmic and trigonometric functions; and modeling data and applied situations with specific functions for analysis. Exponential, logarithmic and trigonometric functions receive major focus. The course also presents systems of linear equations and analytic geometry.

The course will emphasize understanding of concepts, interpretations, applications and written exposition of results while developing relevant skills. The use of technology in the form of graphing calculators or computers is dependent upon the individual instructor.

The course will fulfill the Liberal Studies Foundations Mathematics requirement. With regard to themes, environmental applications occur in models of growth and decay covered along with exponential and logarithmic functions and models of periodic behavior covered in the trigonometry portion. Furthermore, the course is foundational to the study and application of technology. The essential skills most prominent in the course are: quantitative and spatial reasoning; critical reading needed in stated problems to ascertain the objective, the pertinent information and the appropriate tools to apply; critical thinking needed to identify patterns or characteristics in given information in order to properly categorize functions, to construct logical exposition of mathematics and to draw inference from observations of data and graphs; and effective writing of solutions and conclusions, although often only consisting of a single sentence conclusion.
Placement Level:
Students entering the university without deficiency based on the completion of Algebra I, Geometry, Advanced Algebra, and a fourth mathematics course that is algebra based will be placed into MAT 125. It will have the same placement level as MAT 110 and MAT 114.

Student Learning Expectations: Via homework, quizzes, and examinations, it will be verified that upon completion of the course, students will be able to:

1. Analyze, graph, create and discuss properties of functions, especially to:
   a. sketch graphs from formulas or tables;
   b. relate graphical, numerical and algebraic properties: zeros, factors, intercepts, asymptotes, intervals of increase or decrease, domain and range, functional values, minima and maxima, end behavior, dominance, period, frequency and amplitude;
   c. use function notation in computations, combinations of functions, and analyzing properties of functions such as symmetry and comparisons;
   d. use translation, scaling, reflection and symmetry in graphing and comparing functions; identify such features from formulas and graphs;
   e. sketch by hand basic graphs of linear, quadratic, reciprocal, polynomial, rational, square root, absolute value, exponential, logarithm, sine, cosine and tangent functions and combinations of these functions;
   f. compose and decompose functions; identify which functions have inverses; compute and make use of inverses.

2. Use basic properties of elementary functions and their inverses including linear, quadratic, reciprocal, polynomial, rational, square root, absolute value, exponential, logarithm, sine, cosine and tangent functions and combinations of these functions to:
   a. compute and/or report function values;
   b. analyze and discuss function behavior;
   c. solve exactly or approximately equations and inequalities graphically, numerically and analytically; report solutions and discuss their nature and implications;
   d. use limit notation for end behavior and asymptotic behavior;
   e. verify and derive identities.

3. Construct a formula or equation using the appropriate type of function to fit given data, a graph, or an applied physical situation, especially involving rational functions, linear or exponential growth or decay, periodic behavior, or triangular formulation, analyze the function or solve the equation as appropriate and derive and discuss in writing the desired results.

4. Set up linear systems of equations corresponding to basic applied situations; solve linear systems including under-determined systems using elimination, substitution and augmented matrices; report in writing and describe the

Revised Spring 2009.
nature and implications of solutions.

5. Identify from equations or graphs lines, circles, ellipses, hyperbolas and parabolas; derive and discuss basic features from equations and graphs, including translation and other transformations; construct equations in standard form to fit graphs or given information.

Course Structure and Approach:
The course will use a mix of lecture, discussion, class participation and group activities according to instructor design. Some sections may make use of calculators or computer algebra systems.

Possible Texts:
There are many possible textbooks for the course, including:
(1) Functions Modeling Change, Connally, et. al., Wiley
(2) Precalculus, 5th edition, Cohen, West

Course Outline:
1. Functions and Graphs - 8 days
   The coordinate plane and graphs of relations; linear equations; distance; equations of circles; the concept of function; domain and range; graphs and properties of functions; linear, quadratic, reciprocal and square root functions; compositions; translations, scaling and reflections; symmetry; inverse functions.

2. Polynomial and Rational Functions - 6 days
   Basic shapes of graphs of polynomials and rational functions; dominant terms; end behavior; zeros and factors; continuity; asymptotes; solving equations and inequalities; fitting formulas to data or graphs; complex roots; simple limit notions and notation.

3. Exponential Functions - 10 days
   Exponential growth and comparisons to linear growth; graphs and properties; the number e and the exponential function; common and natural logarithms; exponential and logarithmic equations; growth and decay; fitting formulas to data; exponential models for applications.

4. Trigonometry - 14-15 days
   Review of right triangle trigonometry; sine, cosine and tangent; simple identities (Pythagorean, complementary angles); applications of right triangle trigonometry; sine, cosine and tangent as functions of real numbers; properties of trigonometric functions: period, amplitude, translations and symmetry; graphs of sine, cosine and tangent together with scaling and translations; modeling data, graphs and natural oscillatory behavior with trigonometric functions; basic identities (e.g., sum and difference, double

Revised Spring 2009.
angle) and verification of identities; trigonometric equations; inverse trigonometric functions (arcsine, arctangent), law of sines, law of cosines and applications.

5. Systems of Equations - 3 days
   Review of methods for solving linear systems of equation including use of augmented matrices; nature of solutions; use of parameters to characterize solutions of under-determined systems.

6. Analytic Geometry - 6 days
   Basic shapes associated with linear and quadratic equations, especially circles, ellipses, hyperbolas and parabolas; translations and scaling; identification of shape from equations; graphing conic sections; properties.

7. Additional Topics or Activities - 5 days
   In-class activities; group projects; graphing calculator projects or additional topics chosen from: oblique asymptotes; matrices; nonlinear systems; DeMoivre’s Theorem; vectors; parametric equations; polar coordinates.

8. Exams - 4-6 days

Assessment of Student Learning Outcomes and Timeline:
The assessment procedures include: a minimum of three in-class exams (or equivalent), and some selection of (a) graded homework assignments, (b) quizzes, (c) writing assignments, (d) applied individual or group projects, possibly with technology. There will be a comprehensive final examination worth at least 20% of the overall grade.

Grading System:
Assignment distributions may vary with instructors; the following is representative:
   Homework/Quizzes 20%
   Technology Projects 10%
   Mid-term Exams 50%
   Final Exam 20%

Grades are distributed by the following percentages of the total points possible.

A  90-100%  B  80-89%  C  70-79%  D  60-69%

Course Policies:
Attendance policy – This policy may vary from instructor to instructor

Make-up policy – Activities done in class and counted toward your grade as quizzes cannot be made up in the case of non-institutionally recognized absences. No late work will be accepted except in cases of excused documented absences with prior notification.

Revised Spring 2009.
University policies – Students are responsible for the following policies: Safe Environment, Students with Disabilities, Institutional Review Board, Academic Integrity, and Academic Contact Hour. A copy of these policies may be downloaded from the web site: http://jan.ucc.nau.edu/academic

Revised Spring 2009.