

MATH-MATHEMATICS (MATH)

A student may not receive credit for a lower-division mathematics course if it serves as a prerequisite to a lower-division math course that the student had previously passed with a grade of C- or better.

Students without adequate placement to enroll in MATH 1134, MATH 1215 or MATH 1130G can gain admission to the course by earning a C- or better in CCDM 114 N at an NMSU Community College campus, or in ARSC 1120.

Students wishing to enroll in MATH 1220G, MATH 1430G, MATH 1250G, MATH 1511G, or MATH 1350G must satisfy one of the following:

1. have passed the stated prerequisite course or an equivalent transfer course with a C- or better
2. have placed into the course with an adequate ACT Math score or through the Mathematics Placement Examination (MPE), the results of which will be made available to the student's advisor. The MPE is given daily in Walden Hall when school is in session and during new student orientation programs.

MATH 1130G. Survey of Mathematics

3 Credits (3)

This course will develop students' ability to work with and interpret numerical data, to apply logical and symbolic analysis to a variety of problems, and/or to model phenomena with mathematical or logical reasoning. Topics include financial mathematics used in everyday life situations, statistics, and optional topics from a wide array of authentic contexts. May be repeated up to 3 credits.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in CCDM 113 N or CCDM 114 N.

Learning Outcomes

1. Construct and analyze graphs and/or data sets: Gather and organize information; Understand the purpose and use of various graphical representations such as tables, line graphs, tilings, networks, bar graphs, etc.; Interpret results through graphs, lists, tables, sequences, etc.; Draw conclusions from data or various graphical representations.
2. Use and solve various kinds of equations: Understand the purpose of and use appropriate formulas within a mathematical application; Solve equations within a mathematical application; Check answers to problems and determine the reasonableness of results.
3. Understand and write mathematical explanations using appropriate definitions and symbols: Translate mathematical information into symbolic form; Define mathematical concepts in the student's own words; Use basic mathematical skills to solve problems.
4. Demonstrate problem solving skills within the context of mathematical applications; Show an understanding of a mathematical application both orally and in writing; Choose an effective strategy to solve a problem; Gather and organize relevant information for a given application.

MATH 1134. Fundamentals of Elementary Mathematics I

3 Credits (3)

Numbers and the four operations of arithmetic. Understanding and comparing multiple representations of numbers and operations, in particular how these representations build from whole numbers to integers to fractions and decimals. Applying properties of numbers and operations in contextual situations. Reasoning, communicating, and

problem solving with numbers and operations. Applications to ratio, and connections with algebra. Taught primarily through student activities and investigations. Restricted to: EDUC,EPAR,E ED,ECED majors. May be repeated up to 3 credits.

Prerequisite: C- or better in ENGL 1110G; adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1215.

Learning Outcomes

1. As future elementary teachers you will be teaching mathematics to children.
2. In order to teach a subject well you need not only to know the material that you will teach, but you need to know more than what you will teach, and know it well, in order to be able to answer questions, understand student reasoning, give alternate explanations when your students do not understand something, and be able to adjust to changes in the mathematical curriculum.
3. Furthermore, even if you hope to teach a given grade, you should be prepared to teach a variety of grades since what a person ends up teaching is often not what they planned to do.
4. We will explore ideas of arithmetic in a way to help you improve your mathematical ability, gain confidence in your ability, introduce to you different ideas and models, and to see a variety of mathematical activities that are appropriate for people of all ages.
5. Everything we study will be done with the aim of developing your ability to relate to the mathematics of elementary school and to help children develop mathematical understanding

MATH 1215. Intermediate Algebra

3 Credits (3)

A study of linear and quadratic functions, and an introduction to polynomial, absolute value, rational, radical, exponential, and logarithmic functions. A development of strategies for solving single-variable equations and contextual problems. May be repeated up to 3 credits.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in CCDM 113 N or CCDM 114 N.

Learning Outcomes

1. Students will build on their knowledge of linear and quadratic functions and will begin to build an understanding of absolute value, polynomial, rational, power, radical, exponential and logarithmic functions in the following contexts: Demonstrate appropriate use of basic function language and notation; Convert between equivalent forms of algebraic expressions; Solve single-variable equations of the types listed above; Interpret and communicate algebraic solutions graphically and numerically; Demonstrate contextual problem-solving skills that include setting up and solving problems, and interpreting solutions in context; Apply appropriate problem solving methods from among algebraic, graphical, and numerical.

MATH 1217. General Supplemental Instruction I

1 Credit (2P)

Collaborative workshop for students enrolled in Intermediate Algebra.

Corequisite: MATH 1215.

Learning Outcomes

1. Intermediate Algebra Workshop provides time for students to work on problems from Intermediate Algebra under the guidance of their instructor.

MATH 1220G. College Algebra

3 Credits (3)

The study of equations, functions and graphs, reviewing linear and quadratic functions, and concentrating on polynomial, rational,

exponential and logarithmic functions. Emphasizes algebraic problem solving skills and graphical representation of functions. May be repeated up to 3 credits.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1215.

Learning Outcomes

1. Use function notation; perform function arithmetic, including composition; find inverse functions.
2. Identify functions and their transformations given in algebraic, graphical, numerical, and verbal representations, and explain the connections between these representations.
3. Graph and interpret key feature of functions, e.g., intercepts, leading term, end behavior, asymptotes.
4. Solve equations algebraically to answer questions about graphs, and use graphs to estimate solutions to equations.
5. Solve contextual problems by identifying the appropriate type of function given the context and creating a formula based on the information given.
6. Communicate mathematical information using proper notation and verbal explanations.

MATH 1221. General Supplemental Instruction II

1 Credit (1+2P)

Collaborative workshop for students enrolled in College Algebra.

Corequisite: MATH 1220G.

Learning Outcomes

1. College Algebra Workshop provides time for students to work on problems from College Algebra under the guidance of their instructor.

MATH 1250G. Trigonometry & Pre-Calculus

4 Credits (3+2P)

Trigonometry & Pre-Calculus includes the study of functions in general with emphasis on the elementary functions: algebraic, exponential, logarithmic, trigonometric and inverse trigonometric functions. Topics include rates of change, limits, systems of equations, conic sections, sequences and series, trigonometric equations and identities, complex number, vectors, and applications. May be repeated up to 4 credits.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1220G.

Learning Outcomes

1. (Trigonometry) Students will be able to define and evaluate the trigonometric functions as functions of angle in both degree and radian measure using the definitions in terms of x , y , and r ; as the ratio of sides of a right triangle; using the unit circle; using reference angles, commonly used (0° , 30° , 45° , 60° , 90°) angles and using a calculator.
2. (Trigonometry) Students will be able to solve right triangles. They will be able to draw a sketch in an applied problem when necessary.
3. (Trigonometry) Students will be able to solve non-right triangles using the law of sines and the law of cosines.
4. (Trigonometry) Students will be able to prove trigonometric identities and apply addition and subtraction, double-angle, half-angle and power reduction formulas.
5. (Trigonometry) Students will be able to graph the six trigonometric functions, their transformations and their inverses.
6. (Trigonometry) Students will be able to use algebraic methods, including the use of identities and inverses, to solve trigonometric

equations and demonstrate connections to graphical and numerical representations of the solutions.

7. (Trigonometry) Students will be able to add and subtract vectors in two dimensions. They will be able to use the dot product to project one vector onto another and to determine the angle between two vectors. They will be able to solve a variety of word problems using vectors.
8. (Trigonometry) Students will be able to work with polar coordinates; this includes graphing in polar coordinates and transforming an equation with polar coordinates into one with rectangular coordinates, and vice versa.
9. (Trigonometry) Students will be able to work with the trigonometric form of complex numbers, including using De Moivre's formula. 1
10. (Pre-Calculus) Functions: Reinforce recognizing a function from its graph and from its algebraic expression; Reinforce identification of a one-to-one function graphically and from its algebraic expression; Reinforce identification of inverse functions graphically and algebraically; Reinforce combining functions arithmetically and compositionally; Be able to calculate the average rate of change of a function using the difference quotient and depict it graphically; Be able to find a limiting value of a function and be able to identify and use the notation that describes this. 1
11. (Pre-Calculus) Graphing: Reinforce using key characteristics of functions to graph them; Be able to graph conic sections from their key characteristics such as foci, eccentricity and asymptotes; Be able to identify all functions mentioned from their graphs, describing their key aspects. 1
12. (Pre-Calculus) Solving: Exponential/Logarithmic equations using the rules of exponents and logarithms; Systems of linear equations by elimination; Non-linear systems algebraically and graphically. 1
13. (Pre-Calculus) Applications: Modeling with functions with an emphasis on exponential and logarithmic functions, growth and decay. 1
14. (Pre-Calculus) Sequences and series: Understand the concept and notation of a sequence; Understand the concept and notation of a series; Be able to find limits of basic sequences; Be able to find sums of basic series.

MATH 1350G. Introduction to Statistics

3 Credits (3)

This course discusses the fundamentals of descriptive and inferential statistics. Students will gain introductions to topics such as descriptive statistics, probability and basic probability models used in statistics, sampling and statistical inference, and techniques for the visual presentation of numerical data. These concepts will be illustrated by examples from a variety of fields.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1215 or higher.

Learning Outcomes

1. Explain the general concepts of statistics: Explain and evaluate statistics used in the real world (from a news article, research project, etc.); Use statistical vocabulary appropriately; Distinguish between descriptive and inferential statistics; Distinguish between qualitative and quantitative data; Distinguish between populations and samples, and parameters and statistics; Give examples of independent and dependent variables.
2. Presentation and description of data: Present data graphically using histograms, frequency curves and other statistical graphs; Interpret graphs of data, including histograms and shapes of distributions.

3. Summarize data using measures of central tendency and variation: Calculate and interpret the mean, median, and mode to describe data; Calculate and interpret range, variance, and standard deviation to describe data.
4. Present the concepts of probability: Interpret basic probabilities; Calculate probabilities using compound probability rules and the binomial distribution; Calculate probabilities using the standard normal distribution and relate them to areas under the curve; Determine if the binomial distribution can be approximated with the normal distribution; Describe the relationship between the sampling distribution and the population distribution; Use the central limit theorem to approximate the probability distribution and calculate probabilities.
5. Compute point and interval estimates: Determine the confidence interval for a parameter; Interpret the confidence level and margin of error; Determine whether a statistical technique is appropriate under stated conditions.
6. Perform hypothesis tests: Determine whether a statistical test is appropriate under stated conditions; Identify null and alternative hypothesis; Perform and interpret statistical tests (e.g. z-test, t-test, one-tailed and two-tailed, one-sample, two-sample) and determine whether data is statistically significant; State the conclusion of a hypothesis test; Interpret a p-value as compared to a significance level; Explain why a test can lead us to reject a null hypothesis, not accept one; Distinguish between Type I and Type II errors.
7. Analyze data using regression and correlation: Explain the difference between correlation and causation; Construct and interpret scatter plots; Calculate and interpret the linear correlation coefficient; Determine and use the equation of a least-squares regression line between two variables to make predictions; Interpret the meaning of the coefficient of determination.
8. Optional topics: Inter-quartile range, box-plots, stem-and-leaf plots; Combinations and permutations; The Poisson distribution; Statistical power; Chi-square; Analysis of variance.
6. Find the antiderivative and indefinite integral functions to include integration by substitution. Apply the Fundamental Theorem of Calculus in computing definite integrals of functions.
7. Approximate the area under the curve using Riemann sums.
8. Use the integral to determine the area under a curve and to find the accumulated value of a function in context.
9. Solve contextual problems by identifying the appropriate type of function given the context, creating a formula based on the information given, applying knowledge of algebra and calculus, and interpreting the results in context. 1
10. Communicate mathematical information using proper notation and verbal explanations.

MATH 1435. Applications of Calculus I

3 Credits (3)

Intuitive differential calculus with applications to engineering.

Prerequisite(s): C- or better in MATH 1250G.

Learning Outcomes

1. Find limits algebraically and graphically, and use limits to analyze continuity.
2. Find the derivative of a function by applying appropriate techniques (limit of the difference quotient, general derivative rules, product rule, quotient rule, chain rule, and higher order derivatives).
3. Learn derivative rules for polynomial, exponential, logarithmic, trigonometric and inverse trigonometric functions.
4. Perform implicit differentiation. Use implicit differentiation to solve related rate application problems.
5. Find the maxima, minima, points of inflections, and determine concavity of a function by applying the first and second derivatives. Use these results to sketch graphs of functions and to solve optimization problems in context.
6. Find partial derivatives and find maxima, minima in three dimensions.
7. Find the linear approximation of a function.
8. Find Maclaurin and Taylor series.
9. Find limits via L'Hospital's rule. 1
10. Communicate mathematical information using proper notation and verbal explanations.

MATH 1440. Applications of Calculus II

3 Credits (3)

Topics in this second course of Applications of Calculus include functions of several variables, techniques of integration, an introduction to basic differential equations, and other applications.

Prerequisites: C or better in MATH 1435 or in MATH 1521G, or in MATH 1521H.

Learning Outcomes

1. Find definite and indefinite integrals using integration by parts, integral tables, and numerical integration.
2. Analyze multivariable functions using partial derivatives and double integrals, and apply these techniques to applications such as optimization, least squares, and volumes.
3. Solve differential equations graphically, numerically, and algebraically using separation of variables, and apply differential equations in context.
4. Apply differentiation and integration to other areas, for example to Taylor polynomials and Taylor series, probability, trigonometric functions, etc.

MATH 1430G. Applications of Calculus I

3 Credits (2+2P)

An algebraic and graphical study of derivatives and integrals, with an emphasis on applications to business, social science, economics and the sciences. May be repeated up to 3 credits.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1220G or higher.

Learning Outcomes

1. Find limits algebraically and graphically, and use limits to analyze continuity.
2. Find the derivative of a function by applying appropriate techniques (limit of the difference quotient, general derivative rules, product rule, quotient rule, chain rule, and higher order derivatives).
3. Perform implicit differentiation. Use implicit differentiation to solve related rate application problems.
4. Use the derivative to describe the rate of change and slope of a curve in general and at particular points. Compare and contrast average rates of change to instantaneous rates of change.
5. Find the maxima, minima, points of inflections, and determine concavity of a function by applying the first and second derivatives. Use these results to sketch graphs of functions and to solve optimization problems in context.

MATH 1511G. Calculus and Analytic Geometry I**4 Credits (4)**

Limits and continuity, theory and computation of derivatives, applications of derivatives, extreme values, critical points, derivative tests, L'Hopital's Rule. May be repeated up to 4 credits.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1250G.

Learning Outcomes

1. The goals are to present the concepts of calculus, stressing techniques, applications, and problem solving, and emphasizing numerical aspects such as approximations and order of magnitude.
2. Overall, the goals are to illustrate the power of calculus as a tool for modeling situations arising in physics, science, engineering and other fields.
3. In fulfillment of these goals, this and later courses will stress topics such as polynomial approximation, setting up integrals, as well as the use of appropriate technology.

MATH 1511H. Calculus and Analytic Geometry I Honors**4 Credits (4)**

Limits and continuity, theory and computation of derivatives, applications of derivatives, extreme values, critical points, derivative tests, L'Hopital's Rule. This is an Honors version of MATH 1511G. It is taught with MATH 1511G with differentiated assignments.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1250G or higher.

Learning Outcomes

1. The goals are to present the concepts of calculus, stressing techniques, applications, and problem solving, and emphasizing numerical aspects such as approximations and order of magnitude.
2. Overall, the goals are to illustrate the power of calculus as a tool for modeling situations arising in physics, science, engineering and other fields.
3. In fulfillment of these goals, this and later courses will stress topics such as polynomial approximation, setting up integrals, as well as the use of appropriate technology.
4. Gain a deeper understanding of the mathematics behind Limits and Derivatives and be able to use mathematical ideas (such as the Intermediate Value Theorem, the Mean Value Theorem, and the Extreme Value Theorem) in applied contexts.

MATH 1521G. Calculus and Analytic Geometry II**4 Credits (4)**

Riemann sums, the definite integral, antiderivatives, fundamental theorems, techniques of integration, applications of integrals, improper integrals, Taylor polynomials, sequences and series, power series and Taylor series. May be repeated up to 4 credits.

Prerequisite: C- or better in MATH 1511G.

Learning Outcomes

1. Recognize the interplay between Riemann sums and definite integrals
2. Use the Fundamental Theorem of Calculus to compute definite and indefinite integrals
3. Demonstrate an understand of the relationship between the derivative and the definite integral
4. Evaluate integrals numerically using standard rules (midpoint, trapezoid, Simpson's)

5. Evaluate integrals analytically using standard methods (substitution, integration by parts, trigonometric substitution and identities, inverse functions and partial fractions
6. Use integration to solve problems in geometry, physics, science, engineering and other fields
7. Use appropriate methods such as L'Hopital's Rule to evaluate improper integrals
8. Approximate functions using Taylor polynomials
9. Apply standard tests to determine convergence or divergence of sequences and series 1
10. Find a power series representation for a function and determine where it converges 1
11. Identify and evaluate first order differential equations

MATH 1521H. Calculus and Analytic Geometry II Honors**4 Credits (4)**

A more advanced treatment of the material of MATH 1521G with additional topics. Consent of Instructor required. Restricted to Las Cruces campus only.

Learning Outcomes

1. Recognize the interplay between Riemann sums and definite integrals.
2. Use the Fundamental Theorem of Calculus to compute definite and indefinite integrals.
3. Demonstrate an understand of the relationship between the derivative and the definite integral.
4. Evaluate integrals numerically using standard rules (midpoint, trapezoid, Simpson's).
5. Evaluate integrals analytically using standard methods (substitution, integration by parts, trigonometric substitution and identities, inverse functions and partial fractions.
6. Use integration to solve problems in geometry, physics, science, engineering and other fields.
7. Use appropriate methods such as L'Hopital's Rule to evaluate improper integrals.
8. Approximate functions using Taylor polynomials.
9. Apply standard tests to determine convergence or divergence of sequences and series. 1
10. Find a power series representation for a function and determine where it converges. 1
11. Identify and evaluate first order differential equations.

MATH 1531. Introduction to Higher Mathematics**3 Credits (3)**

Logic; sets, relations, and functions; introduction to mathematical proofs.

Prerequisite(s): C- or better in MATH 1521G or MATH 1521H.

Learning Outcomes

1. The primary objective of this course is to serve as a bridge between the calculus courses you have taken, where the focus is on computations and solving problems, to more abstract mathematics courses.
2. In particular, we will discuss logical reasoning, definitions, proofs, and certain basic building blocks such as sets, functions, and relations.
3. By the end of the course, you should be able to understand and construct well-written proofs of basic mathematical arguments involving simple properties of the real numbers, integers, sets, functions, and relations using universal and existential quantifiers,

absolute values and inequalities, modular arithmetic, and proof by induction.

MATH 1531H. Introduction to Higher Mathematics Honors

3 Credits (3)

Logic; sets, relations, and functions; introduction to mathematical proofs. A more advanced treatment of the material of MATH 1531 with additional topics and/or assignments. Consent of Instructor required. Restricted to Las Cruces campus only.

Prerequisite: C- or better in MATH 1521G or MATH 1521H.

Learning Outcomes

1. The primary objective of this course is to serve as a bridge between the calculus courses you have taken, where the focus is on computations and solving problems, to more abstract mathematics courses.
2. In particular, we will discuss logical reasoning, definitions, proofs, and certain basic building blocks such as sets, functions, and relations.
3. By the end of the course, you should be able to understand and construct well-written proofs of basic mathematical arguments involving simple properties of the real numbers, integers, sets, functions, and relations using universal and existential quantifiers, absolute values and inequalities, modular arithmetic, and proof by induction.
4. Since this is an honors course, you should be able to understand higher-level properties of the mathematical objects and ideas arising in the class. You should also be able to write, edit, revise, and ultimately construct well-written proofs and mathematical arguments.

MATH 1996. Topics in Mathematics

1-3 Credits

Topics to be announced in the Schedule of Classes. Maximum of 3 credits per semester. Total credit not to exceed 6 credits. Community Colleges only.

Prerequisite: consent of instructor.

Learning Outcomes

1. Varies

MATH 2134G. Fundamentals of Elementary Math II

3 Credits (3)

Geometry and measurement. Multiple approaches to solving problems and understanding concepts in geometry. Analyzing and constructing two- and three-dimensional shapes. Measurable attributes, including angle, length, area, and volume. Understanding and applying units and unit conversions. Transformations, congruence, and symmetry. Scale factor and similarity. Coordinate geometry and connections with algebra. Reasoning and communicating about geometric concepts. Taught primarily through student activities and investigations. May be repeated up to 3 credits.

Prerequisite: C- or better in MATH 1134.

Learning Outcomes

1. The primary objectives are mathematical: to understand some of the basic concepts of geometry, and measurement with an appropriate level of rigor; to appreciate the historical, cultural and educational contributions and potential applications in real life situations; and to gain problem solving skills using these concepts.
2. The secondary goal is to appreciate the importance of this material in the elementary school curriculum.

MATH 2350G. Statistical Methods

3 Credits (3)

Exploratory data analysis. Introduction to probability, random variables and probability distributions. Concepts of Central Limit Theorem and Sampling Distributions such as sample mean and sample proportion. Estimation and hypothesis testing single population parameter for means and proportions and difference of two population parameters for means and proportions. Analysis categorical data for goodness of fit. Fitting simple linear regression model and inference for regression parameters. Analysis of variance for several population means. Techniques in data analysis using statistical packages. May be repeated up to 3 credits.

Prerequisite: Adequate scoring on the Mathematics Placement Exam, or any ACT/SAT and GPA combination that is considered equivalent, or a C- or better in MATH 1215 or higher.

Learning Outcomes

1. Summarize Data through graphs and Descriptive statistics: Define qualitative and quantitative data; Provide examples of a population, a sample, independent and dependent variables, parameters and statistics; Construct and interpret histograms, stem plots, bar charts, and boxplot; Summarize distributions with numerical measures such as mean, median, standard deviation, percentiles, interquartile range.
2. Present the concepts of probability: Explain related to probability axioms (e.g. mutually exclusive events and independent events); Apply applications of probability rules; Apply Conditional probability and Bayes Rule.
3. Distinguish between discrete and continuous random variables: Calculate probabilities using Binomial and Poisson distributions; Calculate probabilities using the standard normal distribution by finding the area underneath the curve.
4. Explain the Central Limit Theorem: Introduce the concept of a sampling distribution; Discuss the distribution of the sample mean and sample proportion under repeated sampling; Generate and interpret a sampling distribution using repeated sampling; Determine if the Binomial and Poisson distribution can be approximated with the normal distribution.
5. Estimate a population parameter: Determine confidence interval for population mean, proportion, difference of means, and difference of proportions; Interpret the confidence interval and margin of error; Explain the dependence of margin of error on sample size and confidence level.
6. Perform hypothesis tests for population parameters (population mean, proportion, difference of means, and difference of proportions); Describe the logic and framework of the inference of hypothesis testing; Make a decision using a p-value and draw an appropriate conclusion; Distinguish between Type I and Type II errors; Explain power of the test.
7. Perform Hypothesis Tests for Categorical data: Determine and analyze Chi-square test for Independence; Determine and analyze Chi-square test for Goodness of fit.
8. Analyze data using regression and correlation: Construct scatterplots and analyze the scatter plots; Calculate the linear correlation coefficient and determine whether a linear relationship exists between two variables; Fit the least-squares regression line between two variables; Predict the response variable from the regression line; Apply statistical inference to regression parameters.
9. Perform analysis of variance: State hypotheses for the test of several population means; Construct the ANOVA Table; Explain the significance of multiple comparisons. 1
10. Demonstrate the appropriate use of technology (e.g., Excel, an appropriate graphing calculator or other software (Minitab, SAS)

MATH 2415. Introduction to Linear Algebra**3 Credits (3)**

Systems of equations, matrices, vector spaces and linear transformations. Applications to computer science.

Prerequisite(s): Grade of C- or better in MATH 1521G or MATH 1521H.

Learning Outcomes

1. Use row reduction and echelon forms of a matrix to solve linear systems of equations.
2. Use matrix operations, inverse matrices, and matrix factorizations to solve matrix equations.
3. Study the properties of vector spaces and subspaces (e.g., the null and column spaces of a matrix); linear transformations, isomorphisms and kernels; linear independence, bases, and dimension.
4. Apply appropriate matrix manipulations to perform a change of basis.
5. Understand determinants and their properties.
6. Find eigenvalues and eigenvectors and use them to diagonalize matrices.
7. Understand inner product spaces and apply them to real-world problems.

MATH 2530G. Calculus III**3 Credits (3)**

Continuation of Calculus II including multivariate and vector calculus, level curves and surfaces, partial derivatives, gradient, directional derivatives, tangent planes, optimization, multiple integrals in Cartesian, cylindrical and spherical coordinate systems. May be repeated up to 3 credits.

Prerequisite: Grade of C- or better in MATH 1521G or MATH 1521H.

Learning Outcomes

1. Use vector notation correctly.
2. Perform vector operations, including dot product, cross product, differentiation and integration, and demonstrate their geometric interpretations.
3. Perform operations on vector valued functions and functions of a parameter.
4. Identify and graph the equations of cylinders and quadratic surfaces in 3-dimensional space.
5. Determine the domain of continuity of a vector valued function and of a function of multiple variables.
6. Compute partial derivatives, generally and at a point, and sketch their graphical representation on a surface in space.
7. Recognize when the chain rule is needed when differentiating functions of multiple variables, parametric equations and vector valued functions, and be able to use the chain rule in these situations.
8. Compute curvature of a parameterized vector representation of a curve in 2- and 3-dimensional space and be able to explain its meaning.
9. Compute the unit tangent and unit normal vectors to a curve and be able to sketch them with the curve. 1
10. Computationally move among position vector, velocity vector, speed, and acceleration vectors; recognize and demonstrate their use as applied to motion in space. 1
11. Determine the equation of the tangent plane to a surface at a point. 1
12. Use the tangent plane to a surface to approximate values on the surface and estimate error in approximation using differentials 1
13. Compute directional derivatives and represent them graphically relative to the inherent surface. 1

14. Compute the gradient vector; represent it graphically relative to the inherent surface and use it to maximize or minimize rate of change of the function. 1
15. Locate local and global maxima and minima of a function. 1
16. Use Lagrange multipliers to maximize output with one or two constraints. 1
17. Compute arc length and be able to explain its derivation as a limit. 1
18. Calculate double and triple integrals independently and with their geometric representations as surfaces, areas and volumes. 1
19. Calculate iterated integrals in polar, cylindrical and spherical coordinate systems.

MATH 2992. Directed Study**1-3 Credits**

May be repeated for a maximum of 6 credits. Graded S/U.

Prerequisite: consent of the instructor.

Learning Outcomes

1. Varies