

Catalogue Description: Study of functions including graphs, operations and inverses. Includes polynomial, rational, exponential, logarithmic functions and their applications, and systems of equations.

Course Objectives: After completing this course, students will be able to

1. Demonstrate competence with functions and their operations.
2. Solve non-linear algebraic equations and transcendental equations involving logarithms and exponentials.
3. Graphically represent functions and transformations.
4. Model real world phenomena with functions.
5. Communicate mathematical ideas using correct and appropriate notation.

Learning Outcomes and Performance Criteria

1. Apply mathematical concepts and principles to perform computations.

Core Criteria:

- (a) Solve an equation containing rational, exponential or logarithmic expressions.
- (b) Complete the square to solve an equation or to put an equation into a standard form.
- (c) Give the domain of a function whose equation is given.
- (d) Compute and simplify the composition function of two functions.
- (e) Compute the inverse of a function that is a direct composition of other functions.
- (f) Given the factored form of a polynomial function, give the roots of the function. Given the roots of a polynomial function and one additional point that is not a root, give the factored form of the function.
- (g) Give the equations of the vertical and horizontal asymptotes of a rational function whose equation is given.
- (h) Use properties of logarithms to
 - i. write a single logarithm as a linear combination of logarithms
 - ii. write a linear combination of logarithms as a single logarithm

Additional Criteria:

- (i) Solve a general quadratic form equation.
- (j) Solve an equation containing a radical expression.
- (k) Solve an absolute value equation or inequality.
- (l) Solve a polynomial or rational inequality using a sign chart.
- (m) Solve a system of linear equations.
- (n) Solve a system of non-linear equations (or perhaps one linear and one non-linear).

- (o) Find and simplify a difference quotient.
 - (p) Give the range of a function whose equation is given.
 - (q) Given the vertex of a parabola and one other point on the parabola, give the equation of the parabola.
 - (r) Change an exponential equation into logarithm form and vice-versa.
2. Create, use and analyze graphical representations of mathematical relationships.

Core Criteria:

- (a) Recognize the graphs of $y = \sqrt{x}$, $|x|$, $\log_a x$, a^x and a^{-x} , $\frac{1}{x}$.
- (b) Given the graph of a function, identify (as appropriate for the given graph)
 - the domain and range of the function
 - the x - and y -intercepts of the function
 - the equations of horizontal and vertical asymptotes
 - the vertex
 - a function value, like $f(3)$
 - x -values where the function takes a certain value
 - the least possible degree of a polynomial having that graph
 - the inverse function
 - various transformations of the function
- (c) Graph each of the following from an equation:
 - a line
 - a parabola
 - a circle (equation in $(x - h)^2 + (y - k)^2 = r^2$ form)
 - a rational function (equation in factored form)
 - a polynomial function (equation in linear factor form, all roots real)

Additional Criteria:

- (d) Given the graph of a function, identify
 - i. the function as even, odd or neither
 - ii. the intervals on which the function is positive (negative)
 - iii. the intervals on which the function is increasing (decreasing)
 - iv. maxima and minima of the function, and their locations
 - v. limiting behaviors
 - (e) Graph a piecewise defined function from its equation.
 - (f) Determine the equation of a polynomial function (including quadratic) from its graph.
3. Apply mathematics to solve problems.

Core Criteria:

- (a) Solve a problem using a given linear model. Create a linear model for a given situation.

- (b) Create a quadratic model for a given situation.
- (c) Solve a problem using a given exponential model.
- (d) Solve a problem using a given logarithmic model.
- (e) Create an exponential model for a given situation.

Additional Criteria:

- (f) Solve a problem that is modeled by a system of linear equations.
- (g) Determine a half-life or doubling time from given information.