

Math 135 - Pre-Calculus Mathematics

1. Who should enroll?

- o This pre-calculus course can be taken by any student who majors in STEM based on the placement rules after successfully completing Math 126 or being placed into the course.
- o Math 131 is the second in a two-semester precalculus sequence designed for students majoring in STEM. Concepts are covered with the expectation that students are preparing to take Calculus I and beyond.

2. Course Description and Topics Covered

- o This course covers functions and their properties as well as basic concepts of analytic geometry and trigonometry. Topics include linear, quadratic, polynomial, rational, trigonometric, inverse trigonometric, exponential, and logarithmic functions; systems of equations and inequalities; solving applied problems with right triangles; trigonometric identities; polar coordinates; conics; vectors; and sequences and series. This course prepares students for MATH C2210/C2210H (formerly MATH 150/150H). Enrollment Limitation: Not open to students with prior credit in MATH 126, MATH 126S, MATH 131, or MATH 131H.

3. What to expect?

- o **Time:** The most common term lengths are listed below; others would be proportionate. Outside of class time is studying, completing homework, reviewing, etc.

Term Length (weeks)	In-class (hours per week)	Out-of-class (hours per week)	Total weekly time (all types)	Total Term hours (typical)
16	6.6	13.2	19.8	317
8	13.2	26.4	39.6	317

- o **Technology:** Graphing technology is required, and many instructors use the TI-84CE while others use Desmos and Geogebra. Graphing technology is used regularly.
- o This course requires memorization of mathematical facts and formulas. Students will be asked to demonstrate logical arguments and methods of proof.

4. What prior knowledge do students need to know to be successful?

- o Solving Equations
 - Solving linear equations like: $3x + \frac{5}{2} = -7x + 2$
 - Solving quadratic equations by factoring, square root property, completing the square, and quadratic formula like: $3x^2 + 6x + 3 = 45$ or $3x^2 - 3 = 9$
 - Solving radical equations like: $\sqrt{3x - 5} + x = 6$
 - Solving basic exponential and logarithmic equations like: $(1.25)^x = 1000$ or $\log_3 x = 10$
 - Solving rational equations like: $\frac{3}{x+2} - 7 = 5$

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- Solving linear systems of equations like:
$$\begin{cases} 2x - 3y = 5 \\ 7x + 4y = -2 \end{cases}$$
- o Polynomials
 - Addition, subtraction, and multiplication of polynomials like:
$$(3x + 7x^2)(x - 1) = 7x^3 - 7x^2 + 3x^2 - 3x = 7x^3 - 4x^2 - 3x$$
 - Factoring like: $2x^3 - 18x^2 - 8x + 72 = 2(x + 2)(x - 2)(x - 9)$ or
 $6x^2 + 11x - 10 = (3x - 2)(2x + 5)$
 - Factoring algebraic equations for the purposes of solving equations, and completing the square to rewrite equations in different ways like: $x^2 - 6x = y$ turning into $(x - 3)^2 = y + 9$
- o Inequalities and Interval Notation
 - Solving linear inequalities like: $x + 3 > 3x - 5$
 - Writing solutions in interval notation including unions and intersections like:
 $[-5, 7) \cup (7, 13)$
- o Exponents and Radicals
 - Rules of exponents like: $x^a x^b = x^{a+b}$ or $(x^a)^b = x^{ab}$
 - Simplifying radical expressions like: $\sqrt[3]{16x^3} = 2x\sqrt[3]{2}$
 - Rationalizing the denominator like: $\frac{5}{\sqrt{3}} = \frac{5\sqrt{3}}{3}$
- o Rational Expressions
 - Reduce to lowest terms by factoring if necessary like:
$$\frac{x^2 - 9}{(x+3)} = \frac{(x+3)(x-3)}{(x+3)} = x - 3, x \neq -3$$
 - Multiplying and dividing like: $\frac{(x+3)}{(x-2)} \div \frac{(x-6)}{(x^2 - 5x + 6)}$
 - Least common denominator and addition/subtraction like: $\frac{5}{(x-2)} - \frac{7}{(x+3)}$ have a least common denominator of $(x - 2)(x + 3)$
 - Simplifying complex fractions like: $\frac{\frac{2}{x+3}}{\frac{x}{x-3}} = \frac{2(x-3)}{x(x+3)}$
 - Polynomial long division like: $\frac{x^2 - x - 6}{x - 2} = x + 1 - \frac{4}{x - 2}$
- o Complex Number System
 - Standard form of a complex number like: $12 - 7i$
 - Addition, subtraction, multiplication, division of complex numbers like:
$$(3 - i)(2 + 4i) = 6 - 2i + 12i - 4i^2 = 10 + 10i$$
- o Relations and Functions
 - Determine if a relation defines a function like: $f(x) = \sqrt{2 - x}$
 - Evaluating functions like: $f(x) = \frac{2+x}{x}$ when $x = 10 \rightarrow f(10) = \frac{12}{10} = 1.2$
 - Relations and Functions like: $f(x) = \frac{3}{x-2}$ having a domain of $(-\infty, -2) \cup (2, \infty)$ and range of $(-\infty, 0) \cup (0, \infty)$.

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- Inverse functions and their graphs & properties
- Inverses of functions and notation like $f^{-1}(x)$, and knowing this notation is not the same as $(f(x))^2$ or $\frac{1}{f(x)}$
- o Rectangular Coordinate System
 - Graphing a function by plotting points
 - Determine domain and range by looking at a graph
 - Graph vertical and horizontal lines like: $x = 4$ and $y = -2$
- o Linear Functions
 - Find the slope and y-intercept of a linear function like: $f(x) = 3x - 5$ has a slope of 3 and y-intercept of $(0, -5)$
 - Find the equation of a linear function like: $(2, 5)$ and $(4, 13)$ are both points on a line with slope of 4 and y-intercept of $(0, -3)$, so the linear function containing them is $f(x) = 4x - 3$.
 - Find parallel and perpendicular lines given a starting line, like: given an initial line $y = 2x - 3$, the line $y = 2x + 7$ is parallel to it and the line $y = -\frac{1}{2}x + 1$ is perpendicular to it.
- o Logarithmic and Exponential Functions
 - Definitions and Properties like: $e^x e^y = e^{x+y}$, $(7^x)^y = 7^{xy}$, $\ln(e) = 1$, $\log(7^x) = x \log(7)$, $\log(x) + \log(y) = \log(xy)$, etc.
 - Graphs of $f(x) = b^x$ and $f^{-1}(x) = \log_b(x)$