MAC 1140 – PRECALCULUS ALGEBRA

Catalog Description: MAC 1140 Precalculus Algebra (3) (A.A.). Three hours lecture per week. Prerequisite: MAC 1105 or equivalent. Topics include the study of the following functions: Polynomial, rational, radical, absolute value, exponential and logarithmic. An emphasis will be placed on solving applications by mathematical modeling. Other topics include matrices, systems of equations and inequalities, conic sections and sequences. This course is intended for students whose major requires the calculus sequence. Use of a graphing calculator is integrated throughout this course.

Performance Standards:

Upon successful completion of this course, the student should be able to:

1. Form the sum, difference, product and quotient of two functions.
2. Determine the domain and range of a function and determine where a function is increasing, decreasing or constant.
3. Use the graph of a function to determine local maxima and local minima.
4. Graph functions using translations, stretches and reflections of basic graphs.
5. Graph a piece-wise function.
6. Determine the vertex, axis of symmetry and intercepts of a quadratic function.
7. Solve application problems that involve quadratic equations.
8. Identify the real zeros of a polynomial function and their multiplicity.
9. Determine the end behavior of a polynomial function.
10. Identify the domain, end-behavior asymptote(s), horizontal asymptote(s), vertical asymptote(s), and translations, and use these to graph a rational function.
11. Solve polynomial and rational inequalities.
12. Solve application problems requiring the graphing of a rational inequality.
13. Use the Remainder and Factor Theorems, Descartes’ Rule of Signs, Rational Zeros Theorem, the Theorem for Bounds on Zeros, the Intermediate Value Theorem and the Conjugate Pairs Theorem to find all real and complex zeros of a polynomial function.
14. Identify functions that are one-to-one and determine the inverse of a one-to-one function.
15. Evaluate exponential and logarithmic functions and determine their domain.
16. Sketch the graph of a logarithmic equation and exponential equation using transformations.
17. Write an exponential equation as a logarithmic equation and vice versa.
18. Use the Properties of Logarithms to write the logarithmic expression as a sum, difference, or product of simple logarithms.
20. Use compound interest formulas to determine the future value or the present value of a lump sum of money.
21. Analyze parabolas, ellipses and hyperbolas and solve applied problems involving the conic sections.
22. Find the sum, difference and product of two matrices when defined. Find the inverse of a matrix if it exists.
23. Evaluate 2 by 2 and 3 by 3 determinants.
24. Solve a system of equations using substitution, elimination, determinants and inverse matrices.
26. Solve systems of nonlinear equations and inequalities.
27. Identify a sequence as arithmetic or geometric and find recursive and explicit formulas for the nth term.
28. Find the sum of a finite arithmetic or geometric series.
29. Find the sum of an infinite geometric series or state that it is divergent.
30. Write a series using summation notation and evaluate the sum of a series written in summation notation.
32. Use the Binomial Theorem to expand a binomial raised to a power.
1. For \( f(x) = 4 - x \) and \( g(x) = 1 + x^2 \) find a) \( f(x) - g(x) \)  b) \( \frac{f(x + h) - f(x)}{h} \) \( h \neq 0 \)

2. Given the function \( f(x) = |x - 4| + 2 \) sketch a graph of \( f(x) \) using transformations of \( y = |x| \), state the domain and range of \( f(x) \) in interval notation and state the intervals for which \( f(x) \) is decreasing.

3. A camera lens manufacturer estimates that the average monthly cost \( C \), in dollars, of producing a lens is given by the quadratic function \( C(x) = 0.1x^2 - 20x + 2000 \) where \( x \) is the number of lenses the company should produce each month. Find the number of lenses the company should produce per month in order to minimize the average cost.

4. For the polynomial function \( P(x) = (x - a)(x - b)(x - c)^2 \) (assume \( 0 < a < b < c \)), determine the far-left and far-right behavior of the graph, the \( x \)-intercepts and at each \( x \)-intercept indicate whether the graph crosses the \( x \)-axis or touches but does not cross the \( x \)-axis.

5. Sketch a complete graph of \( g(x) = \frac{x + 1}{(x + 4)(x - 3)} \). Label exact values for all intercepts and asymptotes.

6. Find the exact values of all the zeros to \( g(x) = 6x^3 - 13x^2 - 19x + 12 \).

7. Expand \( \ln \left( \frac{x^2 \sqrt{x - 3}}{x + 1} \right) \) completely using the power, product or quotient rules.

8. Solve: \( \log_b (x + 3) + \log_b (x + 4) = 1 \)

9. How long would it take for $500 to grow to $2500 if the money is invested at 8.5% compounded continuously?

10. Given the parabola \( x^2 = -8y \) determine the focus, the equation of the directrix, the focal diameter, the coordinates for the endpoints of the focal diameter, a sketch of the parabola including the vertex and the endpoints of the focal diameter.

11. Draw a sketch of the ellipse \( 9y^2 + 25x^2 = 225 \).

12. Set up a matrix equation and solve using \( X = A^{-1} \cdot B \). Find the equation of the parabola \( y = ax^2 + bx + c \) passing through the points: \((1, 3), (-1, 1), (2, -2)\)

13. Find the sum: \( \sum_{k=2}^{5} (3k - 1) \)

14. Determine the sum of the first 50 terms of the sequence: \( 1, 3, 5, 7, \ldots \)

15. Expand \( (2a + b)^5 \). Write your answer in simplified form.

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