Syllabus

MAT 152 Pre-Calculus (Survey of Functions II)

General Information

Date May 13th, 2024

Author Bryan Ingham

Department Mathematics

Course Prefix MAT

Course Number 152

Course Title Pre-Calculus (Survey of Functions II)

Course Information

Catalog Description This course is a continuation of the study of families of functions from those included in MAT 145, Survey of Functions I. Exponential, logarithmic, trigonometric/sinusoidal, and rational functions are analyzed in depth. Embedded within the study of each of these families are composition, decomposition, and the creation of inverse functions. An introduction to limit notation is used to describe both long and short run behavior. The use of realistic applications and modeling with these families of functions is an essential element of this course. Emphasis on multiple methods of solving equations (algebraic, graphic, and numeric) is included as are multiple representations (algebraic, graphic, numeric, and verbal) of mathematical information.

Credit Hours 3

Lecture Contact Hours 4

Lab Contact Hours 0

Other Contact Hours 0

Grading Scheme Letter

Prerequisites

MAT 145 or Placement into Math Level 3

Co-requisites

None

First Year Experience/Capstone Designation

This course DOES NOT satisfy the outcomes applicable for status as a FYE or Capstone.

SUNY General Education

This course is designated as satisfying a requirement in the following SUNY Gen Ed category
Mathematics (and Quantitative Reasoning)

FLCC Values

Institutional Learning Outcomes Addressed by the Course
Inquiry and Interconnectedness

Course Learning Outcomes

Course Learning Outcomes

1. Generate models using exponential, logarithmic, sinusoidal, and rational functions.
2. Use algebraic skills to compose, decompose and invert functions.
3. Use limit notation to describe both long and short run behavior of functions.
4. Solve equations algebraically, graphically, and numerically (via tables) and evaluate the result for reasonableness.

Outline of Topics Covered

General Outline of Topics Covered:

I. Common to all function families below (embed throughout the course)

- **a. Understanding and using function notation**
- **b. Function evaluation**
- **c. Characteristics of their graphs (increasing, decreasing, concavity, asymptotes, holes etc.)**
- **d. Choosing bounds to graph functions in an appropriate window using a graphing utility**
- **e. Finding zeros and vertical intercept algebraically and graphically**
- **f. Solving for the input of a function given an output algebraically and graphically**
- **g. Solving inequalities related to functions graphically**

h. Interpreting the realistic meaning of the inputs and outputs, zeros and vertical intercept
i. Stating domain and range: both abstract and realistic/relevant
j. Effects of transformations (graphical, algebraic, and verbal)
k. Defining a formula for a function from a given graph, table, and verbal expression
l. Using limit notation to describe the long run behavior of functions
m. Calculating and interpreting average rate of change (AROC).

II. Functions (embed throughout the course)
  a. Evaluating functions with expressions (e.g. difference quotient)
  b. Composition of functions
    i. Evaluation
    ii. Finding formulas algebraically (for all families of functions in the course)
    iii. Domain and range
    iv. Decomposition
  c. Inverse Functions
    i. Definition of a function (review)
    ii. Determining when a function is invertible over its entire domain
      I. Restricting the domain to make functions invertible
    iii. Notation [$x = f^{-1}(y)$] and interpretation
    iv. Constructing the formula of an inverse of a function
    v. Determining if two functions are inverses:
      I. Graphically
      II. Algebraically as individual functions
      III. Algebraically through composition

III. Exponential Functions
  a. General forms and properties of exponential functions

$$y = a(1+r)^t, y = ab^t, y = ae^k, \ \ y = P(1+\frac{R}{n})^{nt}$$

  b. Modeling with exponential functions
  c. Convert growth factors between time scales (eg.: monthly to annual percent rate of change and vice versa)
  d. Development of continuous growth form from compound interest formula
  e. Converting between different forms in part a.

f. Limits at positive/negative infinity

g. Applications: (e.g.: time value of money, population growth, doubling time, half-life, etc.)

IV. Logarithmic Functions

a. Common, natural, and other base logarithms

b. Converting between exponential and log equations (e.g. $2^t = 8$ to $log_2(8) = t$)

c. Use single-sided limit notation to describe the vertical asymptote

d. Properties of logarithms

i. Relationship to exponent rules

ii. Use to simplify and expand algebraic expressions

e. Use logarithms to solve exponential equations

f. Solving logarithmic equations

g. Applications: (e.g. :comparing orders of magnitude, graphing using log scales, decibels, Richter and pH scales, etc.)

V. Trigonometric Functions

a. Sine/cosine/tangent of an angle (review)

b. Center-radius form of a circle

c. Determining (x,y) coordinates on a circle with a given radius and angle measure.

d. Pythagorean identity ($sin^2(\Theta) + cos^2(\Theta) = 1$)

e. Defining radian measure through arc length

f. Converting between radian and degree measure

g. Inverse trigonometric functions (Use both $sin^{-1}()$ and $arcsin()$ notations)

h. Solve equations with sine, cosine, and tangent using radian measure over a restricted domain

i. Sinusoidal functions

i. Finding period, amplitude, frequency, and shift (vertical and horizontal) algebraically and graphically

ii. Interpreting period, amplitude, frequency, and shift (vertical and horizontal) algebraically and graphically

iii. Creating sinusoidal models from graphs, tables, or verbal descriptions

j. Applications: (e.g. : Ferris wheels, daylight hours, pendulums, etc.)

VII. Rational Functions

a. **Polynomial functions (review)**

b. **Algebraic manipulation into** $r(x) = \frac{p(x)}{q(x)}$ **form (including manipulation of complex fractions)**

c. **Long run behavior the from ratio of leading terms**

d. **Use limit notation to describe asymptotic behavior (vertical, horizontal, slant - optional), long run behavior and holes**

e. **Short run behavior: identifying (algebraically and graphically) y-intercept, zeros, undefined values and connection to vertical asymptote(s)**

f. **Applications (e.g.: average cost, concentration, etc.)**