# Mathematics Department
## Brooklyn College, City University of New York
## Math 1231 (Applied Calculus)
## 4 hours, 4 credits

The order in which the topics are presented is left to the instructor's discretion.

1. Introduction to functions
   - Definition of a function: domain, range, and graph
   - Composition of functions
   - Transformations of functions
   - Linear functions
   - Quadratic functions
   - Polynomial and rational functions
   - Exponents
   - Exponential function
   - Logarithmic functions
   - Examples of functions from economics: demand, supply, price, revenue, cost and profit
   - Applications in Economics: market equilibrium
   - Applications in Business: break-even analysis
   - Applications in Finance: continuous compounding of interest; present value

2. Limits and continuity
   - Intuitive definition of limit
   - Properties of limits
   - Limits of polynomials and rational functions
   - Limits at infinity and infinite limits
   - One sided limits
   - Vertical and horizontal asymptotes
   - Continuity and the intermediate value theorem
   - Extreme values (relative and absolute)
   - Continuity and the extreme value theorem

3. The derivative
   - Average rate of change
   - Definition of derivative
   - Interpretation: instantaneous rate of change; slope of the tangent line to the graph of a function
   - Relative and percentage rates of change
   - Differentiation rules
   - Product, quotient, and chain rules
   - Higher order derivatives
   - Marginal analysis, linearization, and differentials
   - Implicit differentiation, isoquants, and related rates

4. Applications of the derivative
   - Critical points of a function, and the closed interval method
   - Intervals of increase and decrease and the first derivative
   - First and second derivative tests for relative extrema
   - Intervals of concavity, points of inflection, and the second derivative
   - Curve sketching and applications
   - Applied optimization
   - Marginal analysis criteria for maximum profit and minimum average cost
   - Price elasticity of demand, levels of elasticity, and effect on revenue

5. Integration
   - Antiderivatives and the indefinite integral
   - Basic differential equations
   - The definite integral and its geometrical interpretation
   - The fundamental theorem of Calculus
   - Net change theorem
   - Integration by substitution
   - Integration by parts (optional topic)
   - Separable differential equations (optional topic)

6. Applications of integration
   - Area between curves
   - Net excess profit
   - Wealth distribution and the Gini index
   - Average value of a function
   - Future and present value of an income stream
   - Consumers' willingness to spend
   - Consumers' and producers' surplus


Some suggested textbooks:
   - Business Calculus, by Calaway, Hoffman and Lippman (Zero cost textbook)
   - Calculus for Business, Economics and the Social and Life Sciences, by Hoffman, Bradley, Sobecki and Price
   - Applied Calculus for Business, Economics and Finance, by Gordon, Wang and Materowski