Calculus II (Math 142) Key Topics (not exhaustive)

Derivatives/Integrals:
- \( \sin f(x), \cos f(x), \tan f(x), \sec f(x), \)  
- \( e^{f(x)}, \ln f(x), \) tangent lines, min/max, asymptotes

Inverse functions, 1-1, implicit differentiation:
- \( \sin^{-1} f(x), \cos^{-1} f(x), \tan^{-1} f(x), \sec^{-1} f(x), \)  
- \( y = f^{-1}(x) \Rightarrow f(y) = x, \left( f^{-1} \right)'(a) = \frac{1}{f'\left[ f^{-1}(a) \right]} \)

Algebra:
- Complete the square, factoring, roots, partial fractions, polynomial division
- Logs and exponents:
  - \( \ln f(x)g(x) = \ln f(x) + \ln g(x) \)  
  - \( \ln f(x)^{g(x)} = g(x) \ln f(x), \quad e^{\ln f(x)} = f(x) = \ln e^{f(x)} \)  
  - \( y = a^{f(x)} \Rightarrow \ln y = f(x) \ln a \Rightarrow y = e^{f(x) \ln a} \)

Geometry:
- Areas of circle, triangle, rectangle
- Similar angle and triangle relationships

Limits:
- Indeterminate Forms
- L’Hôpital’s Rule, manipulation of limit functions into ratios

Integration:
- Areas under \( f(x) \), between \( f(x) \) and \( g(x) \), using slices, symmetry, coordinate selection.
- Improper integrals and integrands that are discontinuous or undefined within limits, absolute value
- Substitution, look for \( f'(x) \) and radical sub, parts, trig strategies, trig substitution, partial fractions.
- Approximate Integration

Applications:
- Volumes: disk/slab/washer, shell
- Arc Length and Surface Area of rotated regions
- Work
- Hydrostatic Pressure
- Moments, mass and laminar system centroids
- First order, separable, initial value problems (exponential growth and decay)