Fall 2016   Math 138   Topics for the exam

Preliminaries about functions. Know:

➢ Formal definition of a function.

➢ Formal definitions of injection, surjection and bijection; important examples of bijections and definitions of the important inverse functions (relevant material posted on September 26 and September 27)

➢ The definition of the composition of functions and have understanding of the website post on September 29 related to this definition

Limits, continuity Know:

➢ The formal definition of limit at $+\infty$ posted on October 2 and how to apply this definition in simple examples (posts of October 2 and October 3)

➢ The ϵ-δ definition of limit at a point a and how to apply this definition in simple examples (post of October 4)

➢ Proofs posted on the website on October 5. (This is closely related to the Lipschitz condition for the existence of limit posted on October 11)

➢ ϵ-δ definition of continuity of a function at a point and how to apply it in simple examples (posts on October 7, October 10 and October 11)

➢ The Intermediate Value Theorem and the Extreme Values Theorem and how to apply them in simple situations

Derivatives. Know:

➢ The formal definition of differentiability and derivative of a function and and how to apply these definitions in simple examples (post of October 14)

➢ the concept of the tangent line to a graph and its connection to the definition of derivative and how to calculate tangent lines to simple graphs

➢ The geometric relationship between the derivative of a bijection and its inverse and how to use it to calculate derivatives of the inverse.

➢ How to use the concept of a tangent line and a normal line to solve geometric problems related to graphs of functions; see post of October 24.

➢ The definition of Lambert's W functions and how to use them to solve simple problems, posts of October 25 and October 26.

Differentiation. Know:

➢ The statement and the geometric interpretation of the mean value theorem and its consequences and how to apply them to do related problems, post of October 25

➢ How to find higher order approximations and the osculating circle for a function at a point, posts of October 28 and November 2

➢ How to solve optimization problems using properties of differentiable functions, lecture of November 4

➢ How to do implicit differentiation and how to use it to analyze simple implicit equations, post of November 7

➢ How to construct parametric equations of simple planar curves and their tangent lines, post of November 10

Integration. Know:

➢ The definition of a Riemann sum of a function, definitions of special Riemann sums: Left, Right, Middle, Lower, Upper, post of November 14

➢ The formal definition of a Riemann integrable function and the definite integral of a function on an interval $[a, b]$, post of November 15

➢ How to use the formal definition to prove that $f(x) = x$ is Riemann integrable on $[a, b]$, post of November 15

➢ How to use the Left, Right, Middle, Lower, Upper Riemann sums and the Trapezoidal rule and the Simpson's rule to find approximations for definite integrals

➢ How to use known areas to find definite integrals

➢ The concept of the average value of a function

➢ The formal statements of the Fundamental Theorem of Calculus and how to use it solve related problems, post of November 16