

MA 109 Tutorial 1

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Hello! I am K. Sreeman Reddy, an 2nd undergraduate student at physics department. Welcome to the 1st tutorial of MA 109. This is going to be a **demo class**. You all have learned Calculus during your 11th and 12th. The main difference between that calculus and this is **rigor** . By rigorous we mean it should follow from definitions and axioms. Historically in the beginning Newton and Leibniz have developed calculus. Their definitions were somewhat vague and not rigorous. So it was all later modified. For example what does it mean to say "*the limiting slope of line joining to points when they are very close is called derivative.*"? This is how it was developed in the beginning, but what does "*limiting*" mean? Sure we can define what limiting means by some vague definition like it is going very near to that value. But these types of vague statements give many problems. We can't always believe in common sense, as many times we can find unintuitive truths in mathematics.



Later Karl Weierstrass gave a rigorous definition of limit-

Definition

Let f be a real-valued function defined on a subset D of the real numbers. Let c be a limit point of D and let L be a real number. We say that

$$\lim_{x \rightarrow c} f(x) = L$$

if

$$\forall \epsilon > 0, \exists \delta > 0, \forall x \in D, 0 < |x - c| < \delta \Rightarrow |f(x) - L| < \epsilon$$

Since this time it is online, professor said you probably will have objective exams except the final exam. (Last time everything was subjective.) In objective it is tough to give questions based on rigor, so objective questions will be similar to JEE questions. **Also next week I have EndSem exams and instead of me Dibyendu Biswas, a PhD student will take the tutorial class. From next week you have to try the questions before coming to the tutorial.**

Example

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a continuous function, satisfying $f(x + y) = f(x)f(y)$; for all $x, y \in \mathbb{R}$ $f(0) = 1$; Find $f(x)$.

In JEE questions you will directly take that $f(x) = a^x$ for some $a > 0$, since they are objective questions. But in this course you can't do that. You have to prove it from what is taught in the course. **In subjective exams you can't ask that it is obvious so I wrote it directly, so I should be given full marks.**

