Lecture 1

Tuesday 28th October, 2014

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1 General Information

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1.1 Office Hours

Monday
16:15 - 17:15
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2 Functions

2.1 Notation

$$\mathbb{N} = \text{Set of all natural numbers} \quad (1)$$
$$\mathbb{Z} = \text{Set of all integers} \quad (2)$$
$$\mathbb{N} = \{\frac{m}{n} : m \in \mathbb{Z}, n \in \mathbb{N}\} \quad (3)$$

2.2 Definitions

2.2.1 Domain, Range and Variables

Let D and E be two sets of real numbers. A function f from D into E is a well defined law which, to each $x \in D$ corresponds to a unique number $y \in E$. The set D is called the domain of f and the set E is called the range of f.
Denote $f : D \to E$ or $y = f(x)$.
The variable x is called independent variable and the variable y is called dependent variable.
The variable x is also called the origin of y and y is also called the image of x.

2.2.2 Image of a function

Given $f : D \to E$. Then the image of f is a set of all $y \in E$ s.t. $\exists x \in D, y = f(x) : I(f) = \{y \in E : \exists x \in D, y = f(x)\}$

2.2.3 Existence domain

The biggest possible domain of a function f is called the existence domain of f.

2.2.4 Graph

A set of point $\{(x, f(x)) : x \in D\}$ in the plane $\mathbb{R}^2$ is called a graph of a function $y = f(x)$.

2.2.5 Even function

If $f(-x) = f(x); (x, -x \in D)$ then, f is called an even function.
Each even function is symmeteric about the y-axis.

2.2.6 Odd function

If $f(-x) = -f(x); (x, -x \in D)$ then, f is called an odd function.
Each odd function is symmeteric about the origin.

2.2.7 Periodical function

A function $y = f(x)$ which is defined on D is called periodical if $\exists T \neq 0$ which is called a period of f s.t. $\forall x \in D \Rightarrow x + T \in D$ and $f(x + T) = f(x)$.
The smallest such $T > 0$ (if it exists) is called the minimal period.

2.2.8 Shifting with respect to y-axis

2.2.9 Shifting with respect to x-axis

2.2.10 Monotonic function

A function $y = f(x)$ is called monotonic increasing (strongly increasing) in D if $\forall x_1, x_2 \in D, x_1 < x_2 \Rightarrow f(x_1) \leq f(x_2) (f(x_1) < f(x_2))$.
A function $y = f(x)$ is called monotonic decreasing (strongly increasing) in D if $\forall x_1, x_2 \in D, x_1 > x_2 \Rightarrow f(x_1) \geq f(x_2) (f(x_1) > f(x_2))$.

2.2.11 One-to-one function

A function $f : D(f) \to E$ is called one-to-one if $\forall y \in I(f) \Rightarrow \exists! x \in D(f)$ s.t. $y = f(x)$.
Equivalently, $\forall x_1, x_2 \in D(f)$, if $f(x_1) = f(x_2) \Rightarrow x_1 = x_2$.