# LECTURE NOTES ON TRIGONOMETRY

*By*

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**Abstract**

In this lecture note, we give detailed explanation and set of problems related to Trigonometry.

**Topic Covered**

Measurement of angles, Relation between degree and radian, Fundamental Identities,

## 1. Motivation

Trigonometry is a very important tool for engineers. There are numerous areas in which engineers utilize trigonometry to develop the solutions to problems.

Trigonometry means the study of the triangle. Most often, it refers to finding angles of a triangle when the lengths of the sides are known, or finding the lengths of two sides when the angles and one of the side lengths are known.

## 2. Angles-Concept

Before defining angle, we will discuss about its components.

### 2.1. Parts of Angles

There are three parts of angles:

1. Initial Side
2. Terminal Side
3. Vertex

**Definition 1.** Measure of angle is **amount of rotation** performed to get the terminal side from the initial side.

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### 2.2. Types of Angles

There are two types of angles:

1. Positive Angle
2. Negative Angle

Positive and negative angles can be defined as follows.

**Definition 2.** If the direction of rotation is performed anticlockwise, the angle is called positive.

**Definition 3.** If the direction of rotation is performed clockwise, the angle is called negative.

## 3. Measurement of Angle

There are mainly three systems of measurement of an angle.

- Sexagesimal system or English system.
- Circular system.
- Centesimal system or French system.

### 3.1. Sexagesimal System

In this system angle is measured in degrees, minutes and seconds.

#### 3.1.1. Degree Measure-Concept

One degree is denoted by $1^\circ$ and is defined as follows.

$$1^\circ := \left(\frac{1}{360}\right)^{\text{th}} \text{ of rotation.}$$

A complete rotation describe $360^\circ$. A degree is divided into 60 minutes and a minutes is divided into 60 second. Symbolically,

$$1^\circ = 60^{'} \text{ and } 1^{'} = 60^{''}.$$

### 3.2. Circular System

In this system angle is measured in radian.

### 3.2.1. Radian Measure-Concept

Angle of one radian measure is defined as follows:

1 radian := Angle subtended at center by arc of length 1 unit in a circle of radius 1 unit.

It can be easily observed that one complete rotation of the initial side subtends an angle of $2\pi$ radian as the circumference of a circle of radius 1 unit is $2\pi$.

## 4. Relation between Degree and Radian

Since a circle subtends at the center an angle whose radian measure is $2\pi$ and its degree measure is $360^\circ$, it follows that

$$2\pi \text{ radian} = 360^\circ \quad \text{or} \quad \pi \text{ radian} = 180^\circ.$$

From above relation we can conclude that

$$1 \text{ radian} = \frac{180^\circ}{\pi} = 57^\circ 16^{'} \quad \text{approximately.}$$

Also,

$$1^\circ = \frac{\pi}{180} \text{ radian} = 0.01746 \text{ radian approximately.}$$

In other words,

$$\text{Radian Measure} = \frac{\pi}{180} \times \text{Degree Measure}$$

$$\text{Degree Measure} = \frac{180}{\pi} \times \text{Radian Measure}$$

**Note:** It is customary to express angle in radians without radian.

### 4.1. Centesimal System or French System.

In this system angle is measured in grades, minutes and seconds. The relation between them is given as belows:

$$1 \text{ right angle} = 100 \text{ grades}$$

$$1 \text{ grade} = 100 \text{ minutes}$$

$$1 \text{ minutes} = 100 \text{ seconds.}$$

**5. Miscellaneous Exercise**

1. Convert $40°20'$ into radian measure.
2. Convert $\frac{5\pi}{12}$ into degree measure.
3. In a circle of diameter 40 cm, the length of a chord is 20 cm. Find the length of the minor arc of the chord.
4. If the angles of a triangle are in the ratio $3 : 4 : 5$, find the smallest angle in degrees and the greatest angle in radians.

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