

VARIOUS MEASUREMENTS OF TIME - I

Due to the intimate relationship with hour angle, right ascension and longitude, the knowledge of measurement of time is most essential. The measurement of time is based upon the apparent motion of heavenly bodies caused by earth's rotation on its axis. Time is the interval which lapses, between any two instants. In the subsequent pages, we shall use the following abbreviations.

G.M.T.	... Greenwich Mean Time	G.M.M.	... Greenwich Mean Midnight
G.A.T.	... Greenwich Apparent Time	L.A.N.	... Local Apparent Noon
G.S.T.	... Greenwich Sidereal Time	L.M.M.	... Local Mean Midnight
L.M.T.	... Local Mean Time	L.Std.T.	... Local Standard Time
L.A.T.	... Local Apparent Time	N.A.	... Nautical Almanac
L.S.T.	... Local Sidereal Time	S.A.	... Star Almanac
G.M.N.	... Greenwich Mean Noon		

The units of time.

There are the following systems used for measuring time :

1. Sidereal Time
2. Mean Solar Time
2. Solar Apparent Time
4. Standard Time

Sidereal Time:

Since the earth rotates on its axis from west to east, all heavenly bodies (i.e. the sun and the fixed stars) appear to revolve from east to west (i.e. in clock-wise direction) around the earth. Such motion of the heavenly bodies is known as apparent motion. We may consider the earth to turn on its axis with absolute regular speed. Due to this, the stars appear to complete one revolution round the celestial pole as centre in constant interval of time, and they cross the observer's meridian twice each day. For astronomical purposes the sidereal day is one of the principal units of time. The sidereal day is the interval of time between two successive upper transits of the first point of Aries (Y). It begins at the instant when the first point of Aries records 0h, 0m, 0s. At any other instant, the sidereal time will be the hour angle of Y reckoned westward from 0h to 24h. The sidereal day is divided into 24 hours, each hour subdivided into 60 minutes and each minute into 60 seconds. However, the position of the Vernal Equinox is not fixed. It has slow (and variable) westward motion caused by the precessional movement of the axis, the actual interval between two transits of the equinox differs about 0.01 second of time from the true time of one rotation.

Local Sidereal Time (L.S.T.):

The local sidereal time is the time interval which has elapsed since the transit of the first point of Aries over the meridian of the place. It is, therefore, a measure of the angle through which the earth has rotated since the equinox was on the meridian. The local sidereal time is, thus, equal to the right ascension of the observer's meridian.

Since the sidereal time is the hour angle of the first point of Aries, the hour angle of a star is the sidereal time that has elapsed since its transit. M1 is the position of a star having SPM1 (= H) as its hour angle measured westward and YPM1 is its right ascension (R.A.) measured eastward. SPY is the hour angle of Y and hence the local sidereal time.

Hence, we have
$$\text{SPM1} + \text{M1PY} = \text{SPY}$$

or **star's hour angle + star's right ascension = local sidereal time** ... (1)

If this sum is greater than 24 hours, deduct 24 hours, while if it is negative add, 24 hours.

The star M2 is in the other position. Y PM2 is its Right Ascension (eastward) and ZPM2 is its hour angle (westward). Evidently,

$$\text{ZPM2 (exterior)} + \text{YPM2} - 24\text{h} = \text{SPY} = \text{L.S.T.}$$

or **star's hour angle + star's right ascension - 24h = L.S.T**

This supports the proposition proved with reference to Fig. 1.30 (a). The relationship is true for all positions of the star.

When the star is on the meridian, its hour angle is zero. Hence equation 1 reduces to

$$\text{Star's right ascension} = \text{local sidereal time at its transit.}$$

A sidereal clock, therefore, records the right ascension of stars as they make their upper transits.

The hour angle and the right ascension are generally measured in time in preference to angular units. Since one complete rotation of celestial sphere through 360° occupies 24 hours, we have

$$24 \text{ hours} = 360^\circ \quad ; \quad 1 \text{ hour} = 15^\circ$$

The difference between the local sidereal times of two places is evidently equal to the difference in their longitudes.