UNIT II: (Paper 503)

[1] The standard (or Geometric) Celestial Sphere:

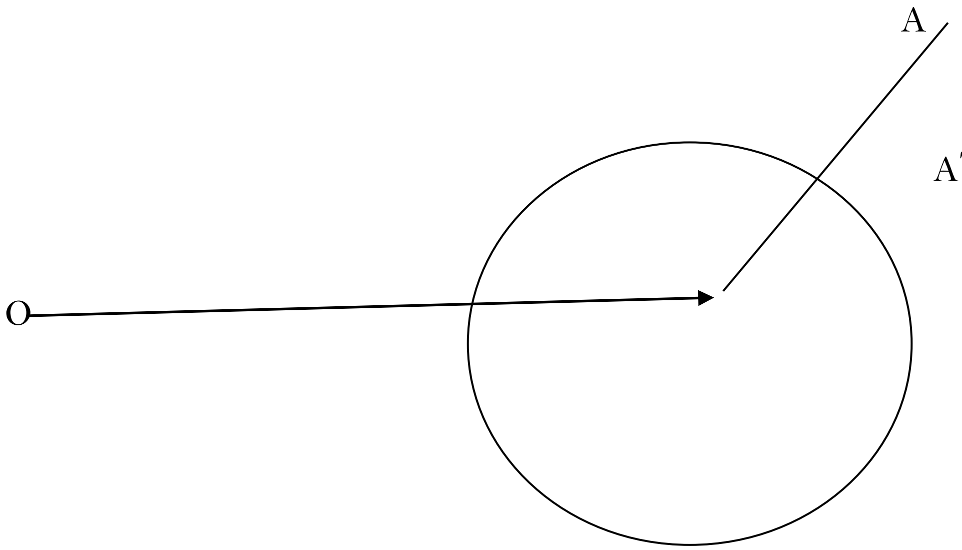


Fig.1

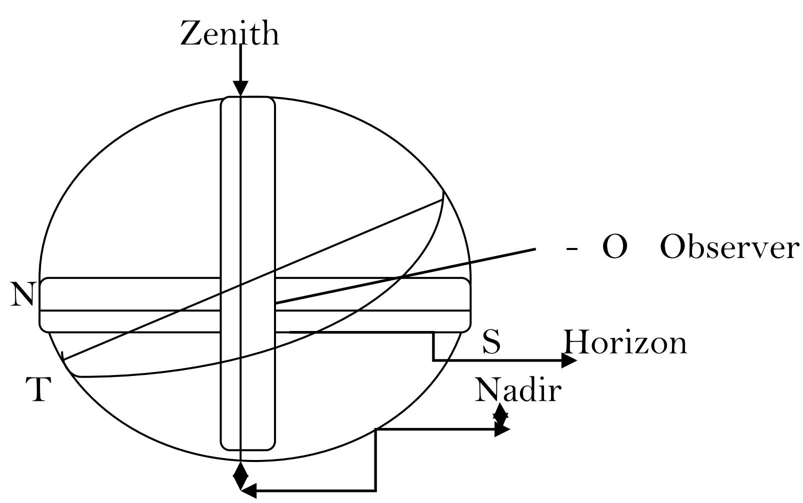
Celestial Sphere:

The sphere on which the heavenly bodies are represented is called "Celestial sphere". Its centre is taken as the eye of the observer.

In Fig. 1 We have, A be the star O be the centre of the sphere. Let the line joining O to A cut the surface of the sphere at A′, then A′ is taken to represent the star on the celestial sphere. For the sake of convenience we often say, that A′ is the star.

Zenith and Nadir:

Fig.2



Definitions:

Let O be the observer on the surface of the earth and with O as centre a celestial sphere be drawn.

Zenith and Nadir:

The line from the centre of the earth to the observer O produced will cut the celestial sphere in two points Z and Na , called Zenith and Nadir, Zenith being vertically above and Nadir vertically below O. Nadir, being directly below the observer, is not visible.

Celestial Horizon:

The plane through O at right angles to OZ is the horizontal plane and it will cut the celestial sphere in the great circle NWSE called the "celestial horizon" or simply "horizon".

UNIT 2:

[1] The standard (or Geometric) Celestial Sphere:

Celestial Sphere: The sphere on which the heavenly bodies are represented is called the celestial sphere. Its centre is taken as the eye of the observer.

[2] System of Coordinates: The position of a point on the celestial can be located by any one of the following:

* Ist system of coordinates :

[i] Azimuth

[ii] Measurement of Azimuth

[iii] Altitude

- Zenith Distance
- Parallel of Altitude

[3] Second system of co ordinates : Right ascension and Declination (α, δ):

*Declination

*Measurement of declination

* North Polar distance
*Right Ascension
[4] 3rd System of Co-ordinates
*Latitude
*Longitude
* Hour Angle
* Parallactic Angle

[3] Conversion of one system to another : Already *Done in class*

[4] **Diurnal motion of heavenly bodies :**

On Account of rotation of earth about its axis from West to East, the celestial sphere and consequently the heavenly bodies have an apparent rotation about the axis of the celestial sphere from east to west. The apparent motion of heavenly bodies is called the "diurnal motion".

[5] **Sidereal time** : On account of the rotation of the earth about its axis , the stars and the sum appears to make one revolution in one day. Also the earth revolves about the sun in a elliptic orbit , due to this sun appears to move with respect to the stars, and make one complete revolution in a year. On account of this relative motion between the stars and the sun it is found that there is difference of time of about four (4) minutes in their apparent uniform rotation about the celestial pole. The time taken by the sun to complete one revolution is called "the mean solar day and that by the stars is called a sidereal day".

Hence 24 sidereal hours = $23^h 56^m 4^N$ mean solar time. As the first point of Aries γ instead of the stars. The sidereal day is the time taken by γ in making one complete revolution with respect to the meridian of any place.

The Sidereal day is the time taken by γ in making one complete revolution with respect to the meridian of any place. Therefore, the sidereal time at any instant is the interval that has elapsed since preceding transit of γ expressed in sidereal hour.

Hence, the sidereal time is measured by west hour angle of γ i.e. by $\angle ZP\gamma$

Thus, sidereal time = $\angle ZP\gamma$

$=\angle ZPX+\angle ZP\gamma$

$=\angle ZPX+\angle \gamma PX$

i.e sidereal time =west hour angle X+R. A of X

i.e. S. T = H+α

Where H is the west hour angle of star X and α is its right ascension.

When the star is on the meridian, its hour angle is zero.

Hence the sidereal time then is equal to the star's right ascension.

When γ is on the observer's meridian, the hour angle of γ will be O^h. When again γ

On the observer's meridian, interval of 24^h of sidereal time has passed. This interval of 24^h

Of the sidereal time is equal to one sidereal day.

NOTE: When the star is on the observer's meridian it is said to transit or culminate.

[6] **Solar time (Mean) :** On account of the rotation of the earth about its axis, the stars and the sun appear to make one revolution in one day. This apparent motion of the heavenly bodies is known as "diurnal motion".

Also the earth the earth revolves about the sun in an elliptic orbit, on account of this , the sun appears to move w.r.t the stars making one complete revolution in one year. Due to this relative motion between the sun and the stars, the apparent uniform rotation of all stars round the celestial is completed in about 4 minutes less time then apparent diurnal revolution of the sun. The time taken by the sun to complete one revolution is called *the mean solar day*, and that by the stars is called the *"sidereal day"*.

Hence, 24 sideral hours $=23^h 56^m 4^s$ mean solar time.

As the first point of Aries γ is practically fixed w.r.t the stars, it is convenient for calculation sidereal time to consider the revolution of γ instead of the stars.

Thus, sidereal day is the time taken by γ in making one complete revolution w.r.to the meridian of any place.

The *sidereal time* at any instant is the interval that has elapsed since the preceding transit of γ expressed in sidereal hour. The sidereal time is measured by the west hour angle of γ i.e. by ∠ZPγ.

Sideral time = ∠ZPγ

=∠ZPγ+∠XPγ = =∠ZPX +=∠γPX i.e. sidereal time.

=West hour angle of *X* + R. A. of X

S. T = H+ α where *H* is the west hour angle and of star *X* and α is its right ascension.

[7] **Rising and setting of stars:**

On account of diurnal motion when a celestial body is crossing the horizon coming up from below it, the body is said to be *rise***,** on the other hand, when the body is crossing the horizon going down below it, the body is said to be *set.*

Let $T'R'$ denotes the diurnal path of a star X cutting the horizon at the points *F* and *G*. Since F is the western side of the horizon, the star sets at *F* and rises at *G*.

When the star is setting its Z.D =Z.F= 90^0 , let H be the hour angle of the star setting and ϕ the latitude of the place. Then

PZ=$90^0 - \phi$; PF=$90^0 - \delta$; ∠ZPH= H .

From right angled triangle ΔPNE , by Napier's rule we have, Sin $\left(H - \frac{\pi}{2}\right) = \tan\phi \quad \tan\delta$

Or $-\mathrm{Cos}H = \tan\phi \quad \tan\delta$

Or $CosH = -\tan\phi \quad \tan\delta$ (1)

Which gives hour angle at rising or setting in terms of ϕ, δ .

From Eq. (1) we see that $\phi > 90^0 - \delta$

= that $\phi > \cot\delta$

= that $\phi \tan\delta > 1$ hence, that $CosH > 1$ numerically.

Thus, from H cannot be found as $CosH$ is always less than unity.

[8] Circumpolar star

[9] Dip of Horizon

[10] Rate of change of Zenith distance and Azimuth examples

[2] System of Coordinates:

[3] Conversion of one system to another :

[4] Dirunal motion of heavily body

[5] Sideral time :

[6] Solar time (Mean) :

[7] Rising and Setting of stars

[8] Circumpolar Star

[9] Dip of Horizon

[10] Rate of change of Zenith distance and Azimuth, examples