CE 103: Surveying

Lecture 14: Astronomical surveying

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Outline

- ❑Zenith, nadir, celestial sphere
- ❑Equator, meridian, eclipse
- ❑Azimuth, Altitude
- ❑Ascension, Declination

Astronomical Surveying : Definition

- Branch of surveying that deals with the observation of celestial bodies (sun, stars) for determining the absolute location of any point or the absolute location and direction of any line on the surface of the earth and also for determining time.

- **Celestial Sphere**:

Imaginary sphere on which the distant stars appear to lie with the earth centre as its centre .

- **The Zenith**

The point on the upper portion of the celestial sphere marked by plumb line above the observer. It is the point on the celestial sphere immediately above the observer's station.

- **The Nadir:**

The point on the lower portion of the celestial sphere marked by plumb line below the observer. It is the point on the celestial sphere immediately below the observer's station.

- **The terrestrial poles and equator**

The terrestrial poles are the two points in which earth's axis of rotation meets earth's sphere. The terrestrial equator is the great circle of the earth , the plane of which is at right angles to the axis of rotation.

- **The celestial poles and equator**

If the earth's axis of rotation is produced indefinitely , it will meet the celestial sphere in two points called the celestial poles. The celestial equator is the great circle of the celestial sphere , the plane of which is at right angles to the axis of rotation.

- **The observer's Meridian**

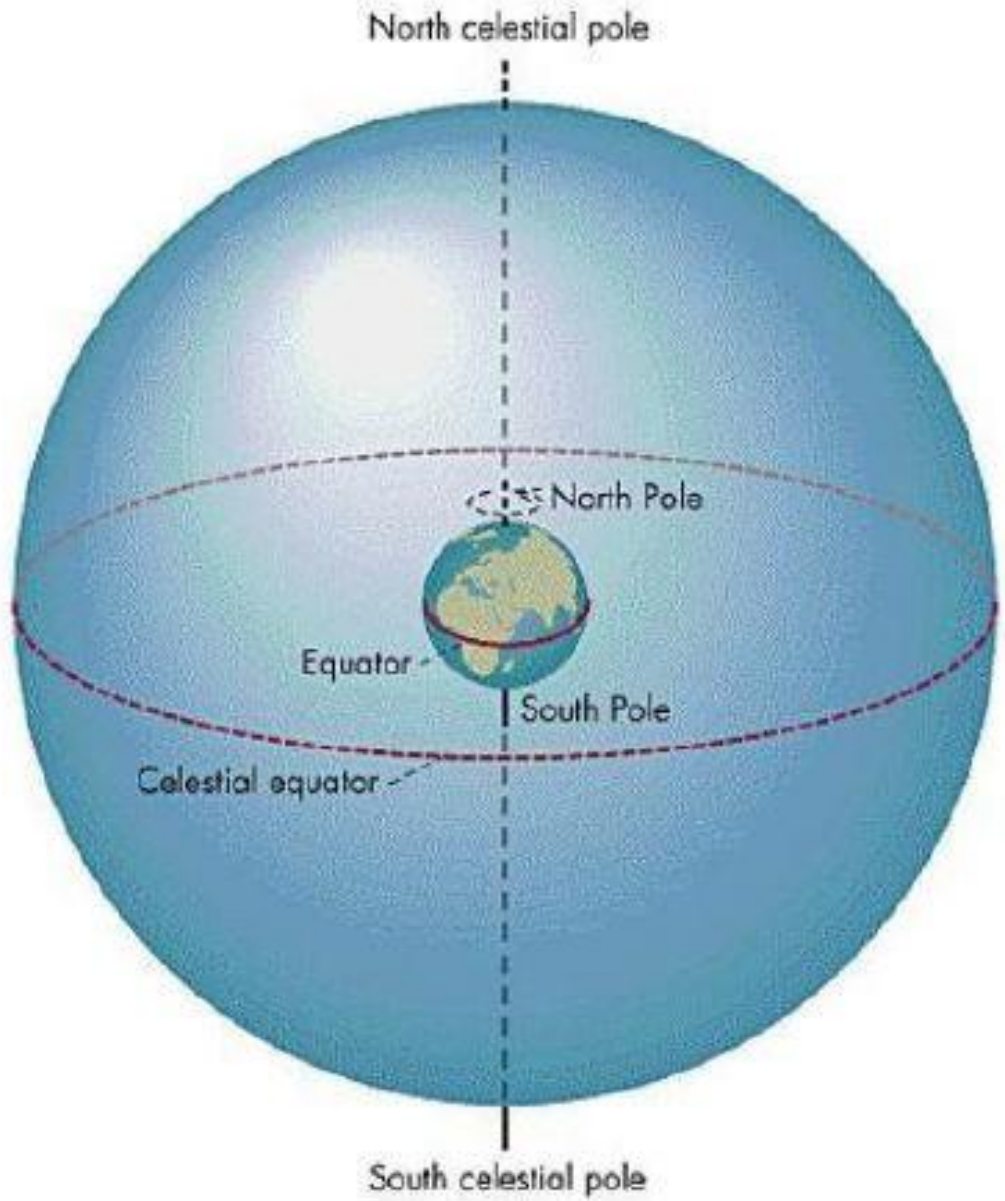
The meridian of any particular point is that circle which passes through the Zenith and the Nadir of the point as well as through the poles.

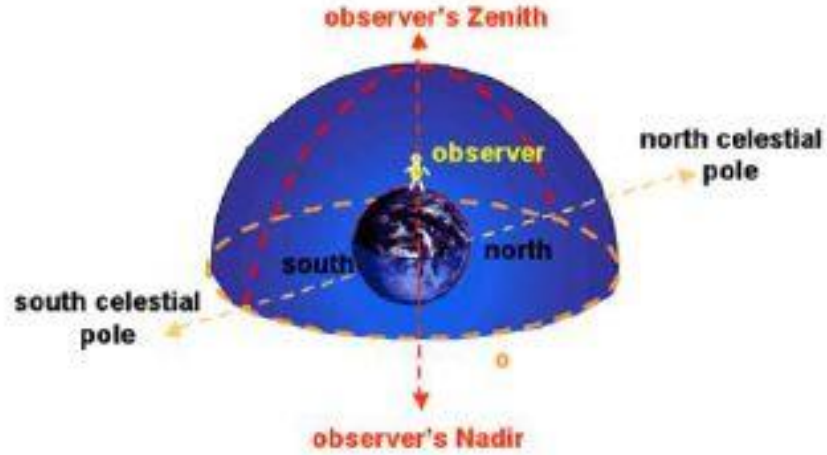
- **The Celestial Horizon**

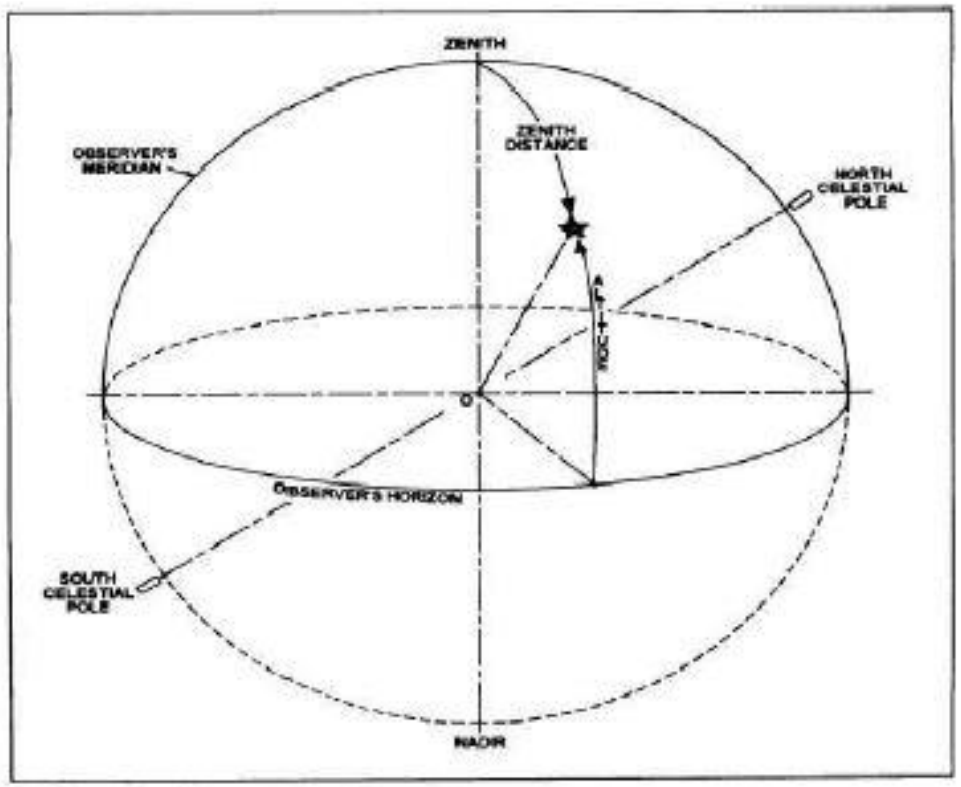
The celestial horizon is the great circle of the celestial sphere , the plane of which is at right angles to the Zenith-Nadir lines and which passes through the centre of the earth.

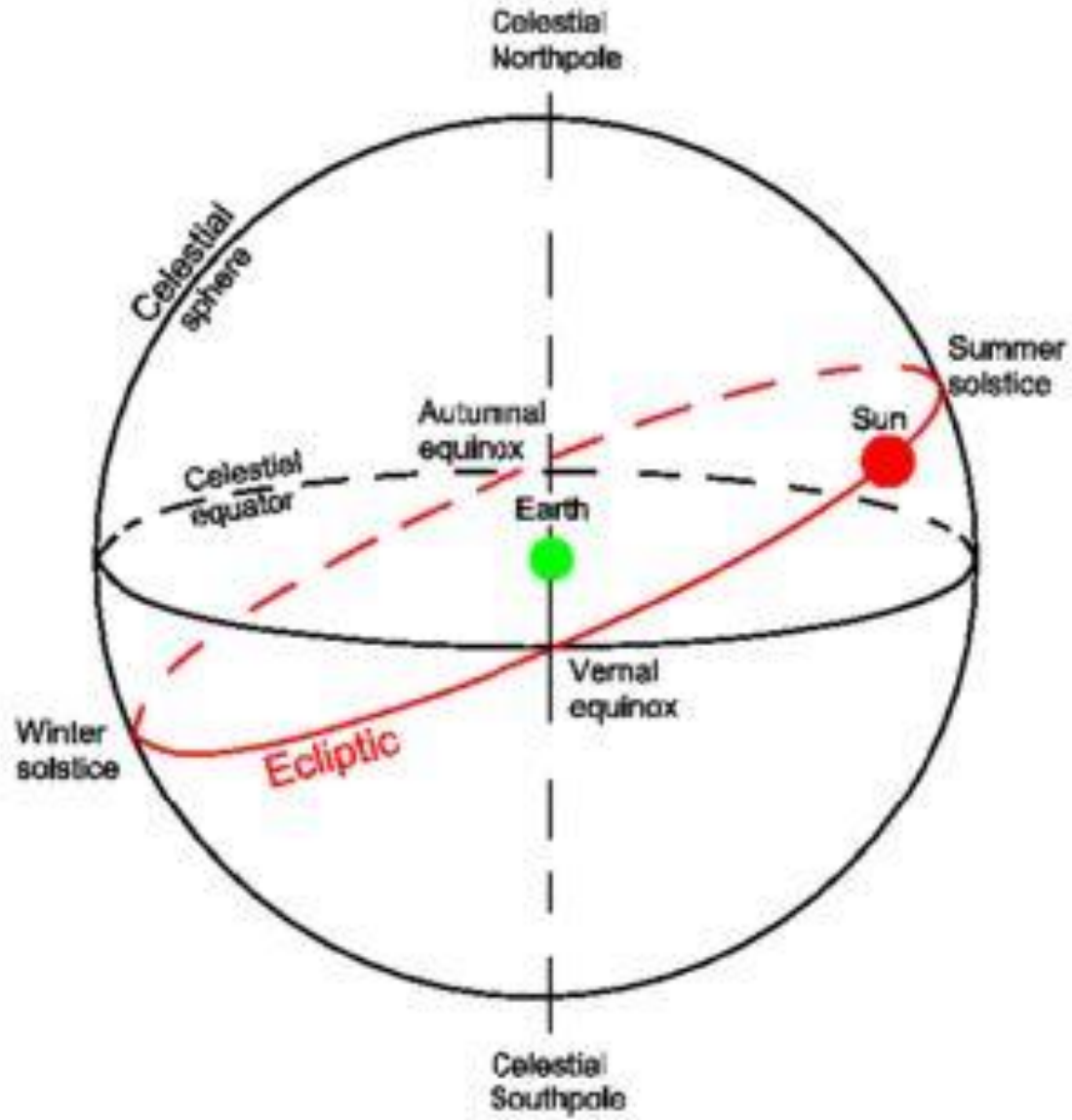
- **The Ecliptic**

The ecliptic is the great circle in which the sun appears to describe on celestial sphere with the earth as a centre in the course of a year.


North celestial pole
North Pole
Equator
South Pole
Celestial equator
South celestial pole


observer's Zenith
observer
north celestial pole
south
north
south celestial pole
o
observer's Nadir


ZENITH
ZENITH DISTANCE
OBSERVER'S MERIDIAN
NORTH CELESTIAL POLE
ALTITUDE
O
OBSERVER'S HORIZON
SOUTH CELESTIAL POLE
NADIR


Celestial
Northpole
Celestial
sphere
Summer
solstice
Autumnal
equinox
Sun
Celestial
equator
Earth
Vernal
equinox
Winter
solstice
Ecliptic
Celestial
Southpole

1. Horizon System:

Azimuth (A):

- Angle measured in horizontal plane.
- In Northern hemisphere ,measured from North eastward or westward (0° to 180°)
- In Southern hemisphere ,measured from South eastward or westward (0° to 180°)

Altitude (α):

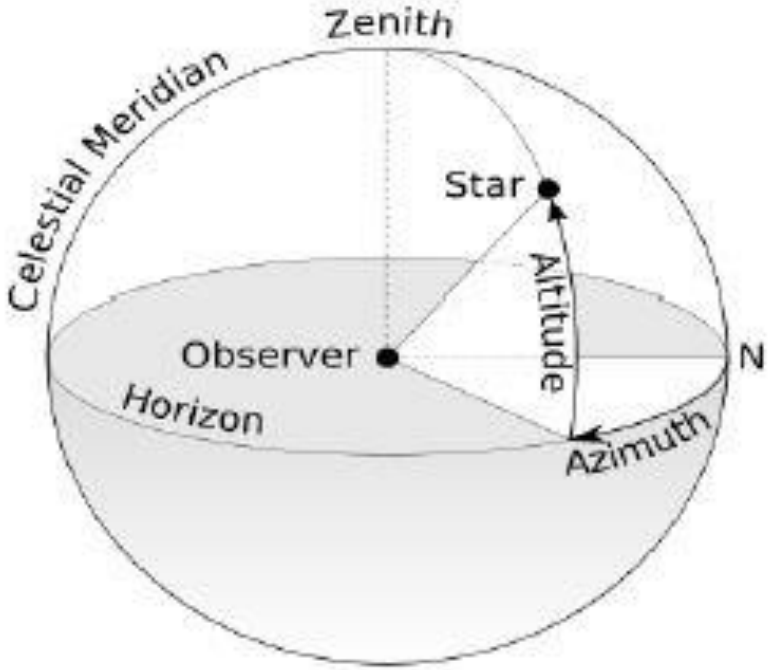
- Angle measured in vertical plane.
- Altitude of Zenith is 90°
- Zenith distance ,z =90°-α

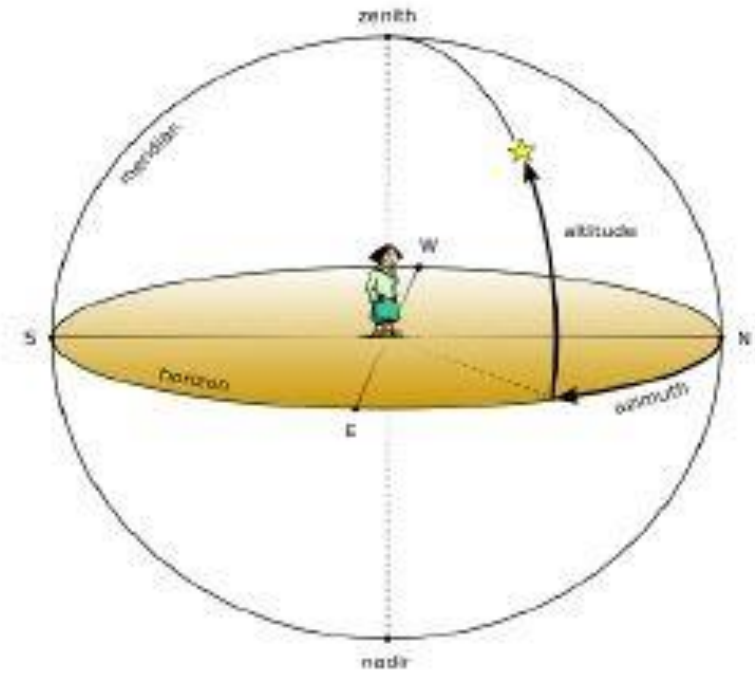
Advantage:

- Easy to visualize.
- Directly Measurable with simple instruments.

Disadvantage:

- These coordinates are dependent on observer's position.


Zenith
Celestial Meridian
Star
Altitude
Observer
N
Horizon
Azimuth


zenith
meridian
altitude
W
S
N
horizon
azimuth
E
nadir

The Coordinate System

2. Independent Equatorial System:

Right Ascension(R.A.):

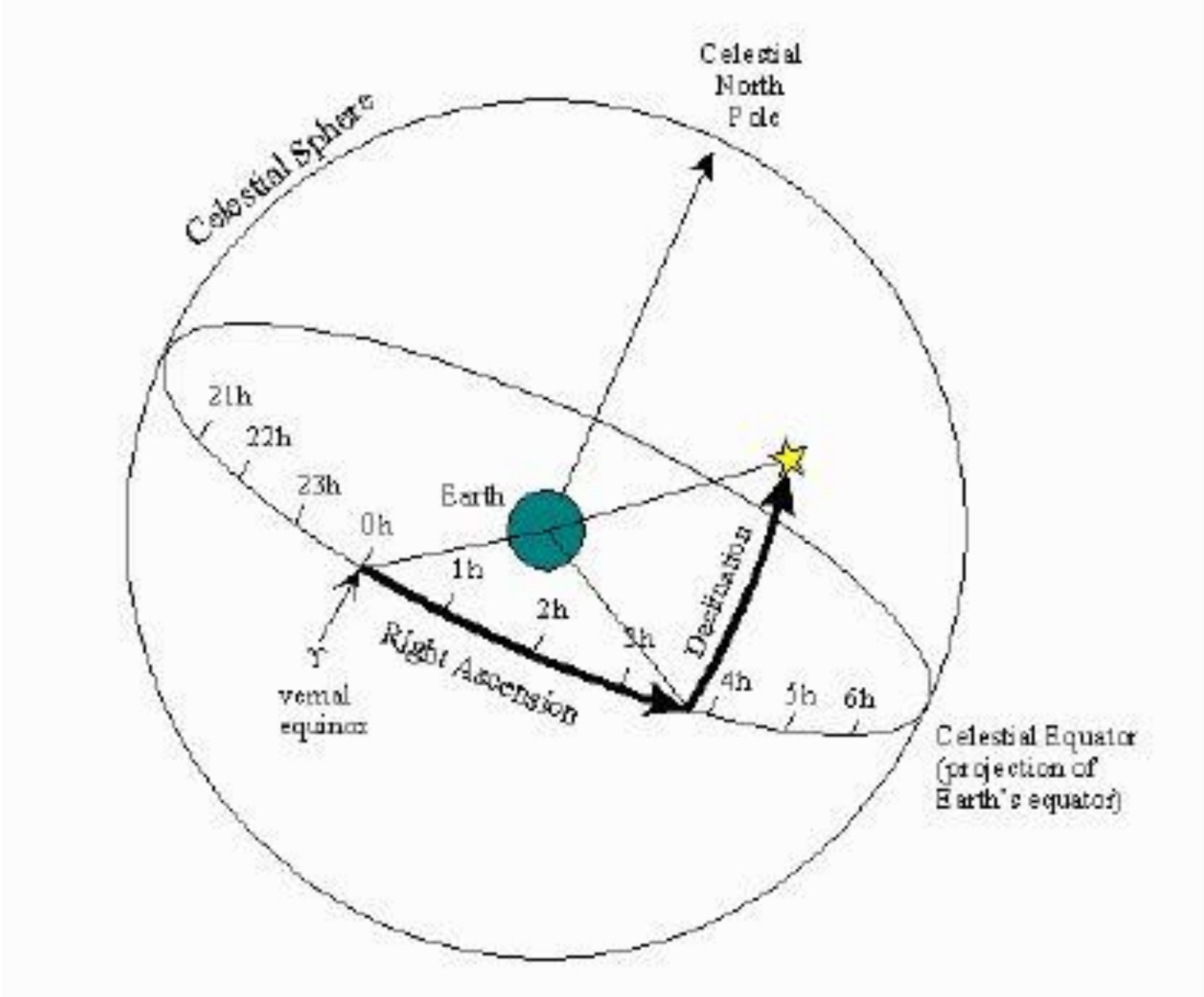
- Angle (Range: 0° to 360°) measured in equatorial plane, eastward from vernal equinox ,the point where the sun's centre crosses the celestial equator moving from south to north.

Declination (δ):

- Angle measured from north (N or +ve) or south (S or –ve) of equator in a plane (plane of declination circle) normal to equatorial plane.
- Range :0° to 90°
- Polar distance,p = 90°-δ

Declination Circle:

- The great circle passing through the heavenly body and the celestial pole.


Celestial
North
Pole
Celestial Sphere
21h
22h
23h
0h
1h
2h
3h
4h
5h
6h
Earth
Destination
Right Ascension
γ
vernal
equinox
Celestial Equator
(projection of
Earth's equator)

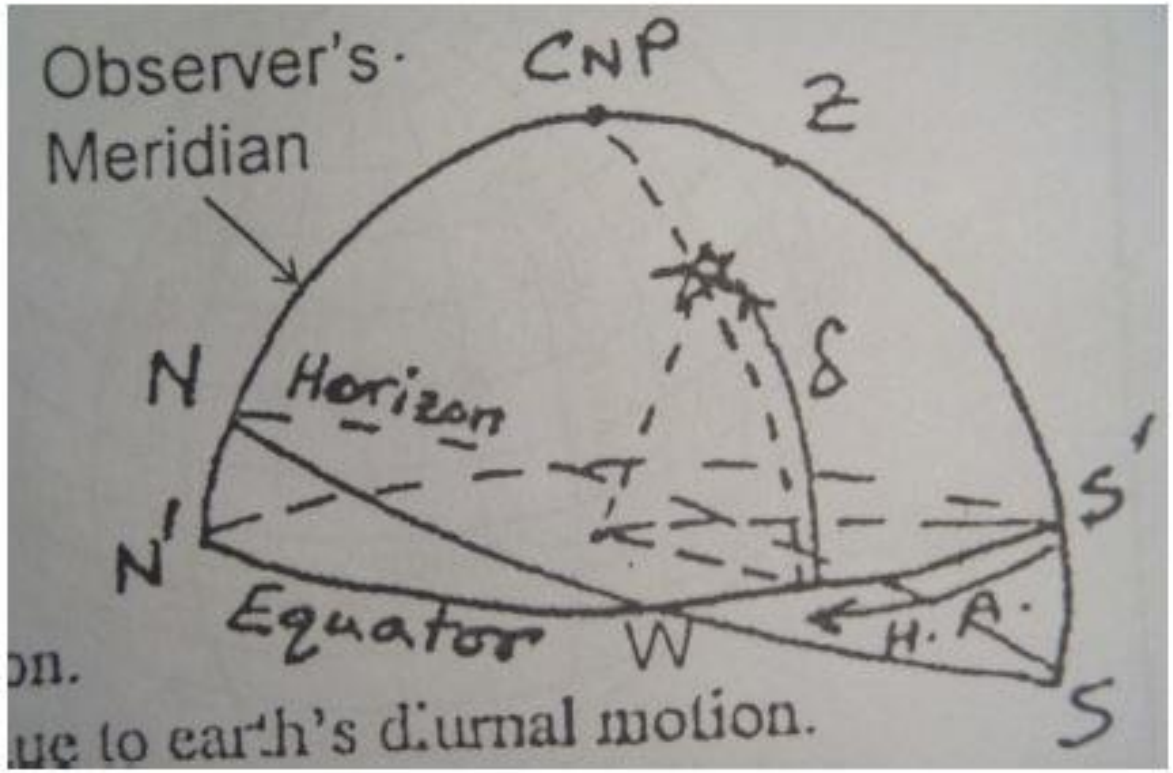
3. Dependent Equatorial System:

Hour Angle (H.A.):

- Angle measured in equtorial plane ,westward from south (Range :0° to 360°)

Declination (δ):

- As described before.



on.
ue to earth's diurnal motion.

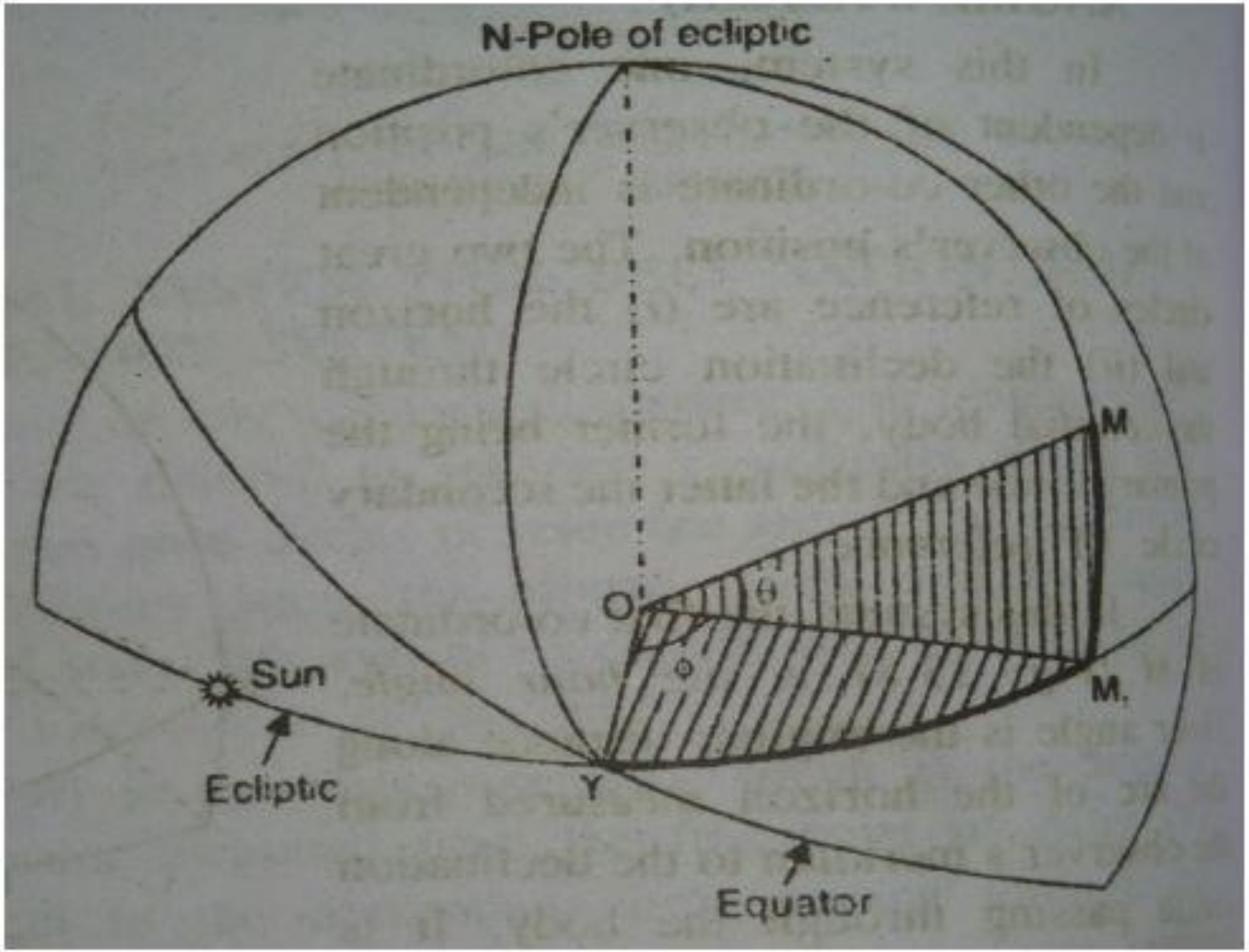
4. Celestial Latitude and Longitude System:

- ***Celestial Longitude (φ):***

Angle measured in plane of ecliptic ,eastward from 1st point of Aries (Range: 0° to 360°)

- ***Celestial Latitude(θ):***

Angle measured in plane normal to plane of ecliptic. (Range :0° to 90° N or S of ecliptic)


N-Pole of ecliptic
M
O
θ
Sun
M.
Ecliptic
Y
Equator