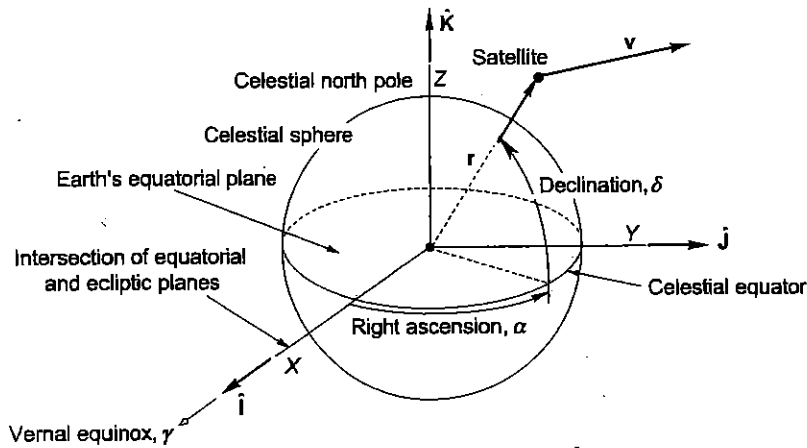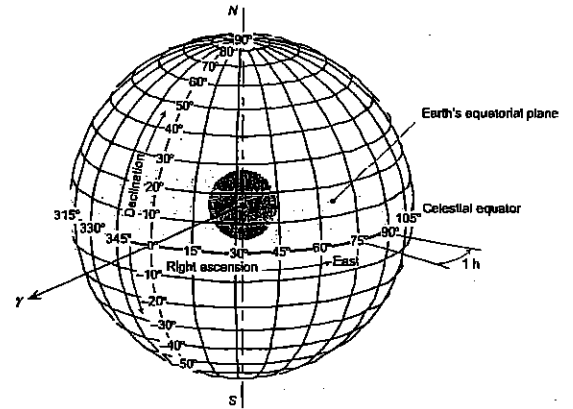Geocentric Right Ascension (RA) and Declination (Dec) Frame

Geocentric Equatorial Frame   Celestial Sphere

Given the position vector $\mathbf{r} = X\mathbf{I} + Y\mathbf{J} + Z\mathbf{K}$, calculate the RA α and Dec δ

1. Calculate the magnitude of $\mathbf{r}$: $r = \sqrt{X^2 + Y^2 + Z^2}$

2. Calculate the direction cosines of $\mathbf{r}$:

$$l = \frac{X}{r} \quad m = \frac{Y}{r} \quad n = \frac{Z}{r}$$

3. Calculate the Dec:

$$\delta = \sin^{-1} n$$

4. Calculate the RA:

$$\alpha = \begin{cases} \cos^{-1}\left(\frac{l}{\cos\delta}\right) & (m > 0) \\[2ex] 360° - \cos^{-1}\left(\frac{l}{\cos\delta}\right) & (m \leq 0) \end{cases}$$