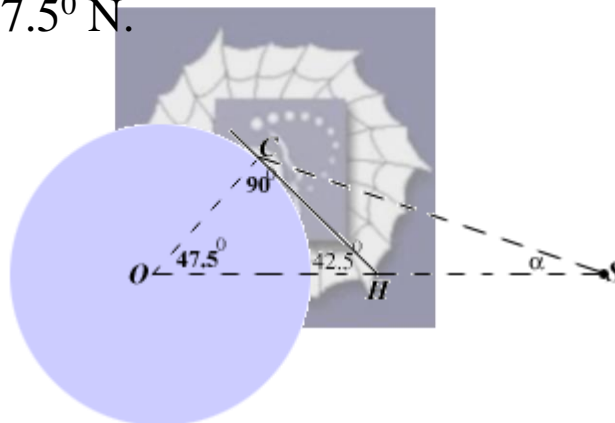


100.

Problem 16.69 (RHK)

Assume that a geosynchronous communication satellite is in orbit at the longitude of Chicago. We have to find the direction in which the axis of a parabolic antenna has to be pointed at Chicago for receiving the maximum signal from the satellite. The latitude of Chicago is 47.5° N.



Solution:

Geometry of the situation is as shown in the diagram.

We use the basic data for a geosynchronous satellite:

$$OS = 4.22 \times 10^7 \text{ m.}$$

$$OC = 6.37 \times 10^6 \text{ m.}$$

Using the law of cosine we will first estimate the distance of the satellite from Chicago:

$$CS^2 = OC^2 + OS^2 - 2OC \cdot OS \cos 47.5^\circ.$$

Substituting the data, we find

$$CS = 3.82 \times 10^7 \text{ m.}$$

We once again use the law of cosine for determining the angle $\angle OSC$. We have

$$2OS \cdot CS \cos \alpha = OS^2 + CS^2 - OC^2 .$$

Substituting the data, we find

$$\cos \alpha = 0.991 ,$$

or

$$\alpha = 7.51^\circ .$$

From the geometry, we note that the angle $\angle SCH$ is

$$\begin{aligned} \angle SCH &= 180^\circ - 137.5^\circ - 7.51^\circ , \\ &= 34.9^\circ . \end{aligned}$$

That is the axis of the parabolic antenna should be pointed at an angle of 34.9° above the horizon in the Southern direction.