Ministry of Education
Government of India

STUDY OF SPHERICAL ASTRONOMY & ECLIPSE FORMATION FROM INDIAN TEXTS

A project by

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UNDER THE GUIDANCE OF

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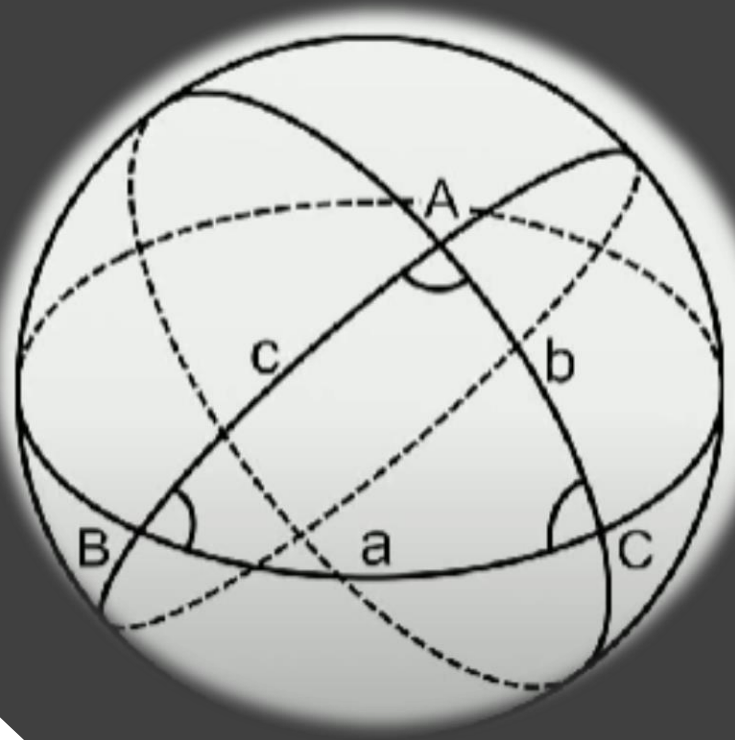
Time-Line

Week 1-2	Reviewing spherical trigonometry theorems and methods
Week 3-4	Problem-solving and verification using the computational software MATLAB.
Week 5	Learning Surya Siddhanta spherical trigonometry
Week 6-7	Understanding the Vedic and Puranic calendar, Surya Siddhanta to predict upcoming celestial events.
Week 8	summarizing all previous work.

Spherical Trigonometry

- A spherical triangle has 6 basic elements: three angles (A,B,C) and three sides (a,b,c).



Arcs & angles

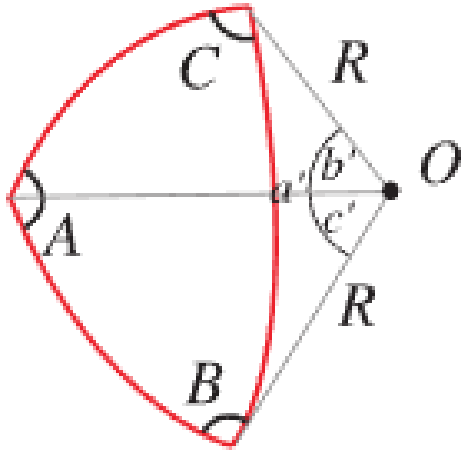
a = OA, **b** = OB, **c** = OC

Angular lengths of the sides (in radians)

a’ = BOC , b’ = COA , c’ = AOB

So Arc Length are

a = Ra’ , b = Rb’ , c = Rc’

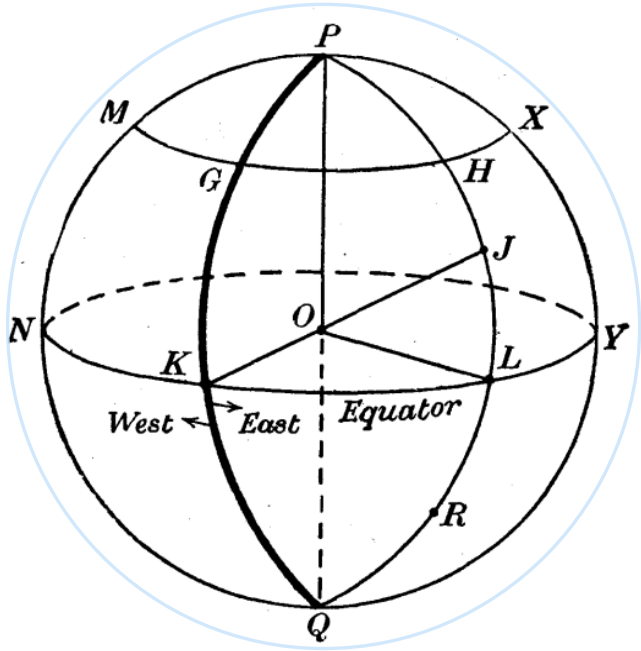


HX = LYsin(PH)

$= LYsin(90 - HL)$

But, HL = ϑ $(latitude)$

So $HX = LYcos\theta$



Fundamental formula of spherical trigonometry

- When **all three Sides** are given

  Angle of triangle can be found by **cosine-formula.**

- For **two sides and one angle**

  Say, b and c , and the included angle A of a spherical triangle ABC are known,

  Then **cosine-formula** can be used to calculate the third side a to be made.

Rules & Laws

1

Fundamental formula of spherical trigonometry

- Cosine-formula

2

Law of Sines

- $\frac{sin\ A}{\sin a} = \frac{\sin B}{\sin b} = \frac{\sin C}{\sin c}$
- Relation between any two sides and two opposite sides

3

Haversine formula

- $\text{hav}(a) = hav(b-c) + \sin(b)\sin(c)\,hav(A)$
- $\text{hav}\theta = sin^2\frac{\theta}{2}$

4

Four parts formula

- $\cos(\text{inner side}).\cos(\text{inner angle}) = \sin(\text{inner side}).\cot(\text{other side}) - \sin(\text{inner angle}).\cot(\text{other angle})$

5

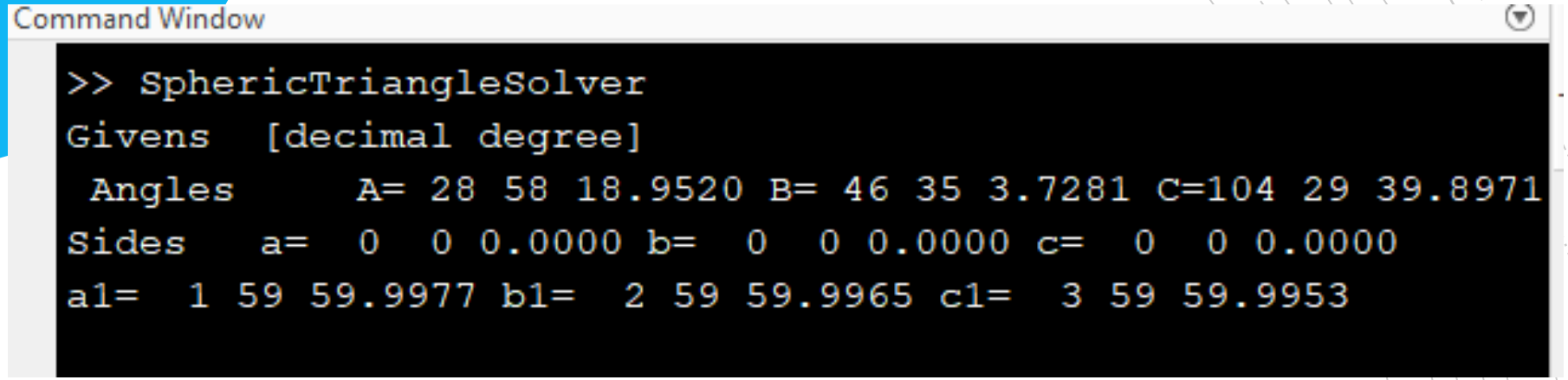
Delambre's & Napier's analogies

- Some further trigonometry calculations provides some useful results

Problem solving & verification

Difficult calculations

MATLAB


Command Window
>> SphericTriangleSolver
Givens [decimal degree]
Angles A= 28 58 18.9520 B= 46 35 3.7281 C=104 29 39.8971
Sides a= 0 0 0.0000 b= 0 0 0.0000 c= 0 0 0.0000
a1= 1 59 59.9977 b1= 2 59 59.9965 c1= 3 59 59.9953