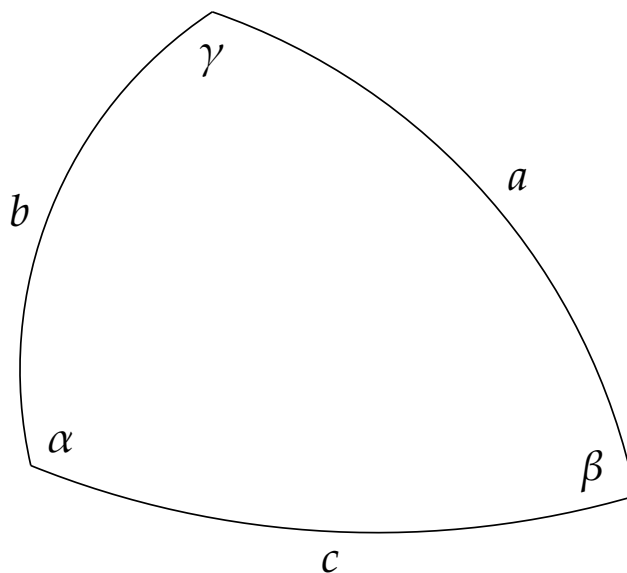


GEODETSKI RAČUNI – VAJE

VAJA 9: SFERNA TRIGONOMETRIJA

2024/2025

1 SPLOŠNI SFERNI TRIKOTNIK



Kosinusni izrek za stranice

$$\cos a = \cos b \cos c + \sin b \sin c \cos \alpha$$

$$\cos b = \cos a \cos c + \sin a \sin c \cos \beta$$

$$\cos c = \cos a \cos b + \sin a \sin b \cos \gamma$$

Kosinusni izrek za kote

$$\cos \alpha = -\cos \beta \cos \gamma + \sin \beta \sin \gamma \cos a$$

$$\cos \beta = -\cos \alpha \cos \gamma + \sin \alpha \sin \gamma \cos b$$

$$\cos \gamma = -\cos \alpha \cos \beta + \sin \alpha \sin \beta \cos c$$

Sinusni izrek

$$\frac{\sin \alpha}{\sin a} = \frac{\sin \beta}{\sin b} = \frac{\sin \gamma}{\sin c}$$

Kotangensni izrek

$$\cot a \sin b = \cos b \cos \gamma + \cot \alpha \sin \gamma$$

$$\cot b \sin c = \cos c \cos \alpha + \cot \beta \sin \alpha$$

$$\cot c \sin b = \cos b \cos \alpha + \cot \gamma \sin \alpha$$

$$\cot a \sin c = \cos c \cos \beta + \cot \alpha \sin \beta$$

$$\cot b \sin a = \cos a \cos \gamma + \cot \beta \sin \gamma$$

$$\cot c \sin a = \cos a \cos \beta + \cot \gamma \sin \beta$$

Napierjeve enačbe (analogije)

$$\tan \frac{\alpha + \beta}{2} = \frac{\cos \frac{a-b}{2}}{\cos \frac{a+b}{2}} \cot \frac{\gamma}{2}$$

$$\tan \frac{\alpha - \beta}{2} = \frac{\sin \frac{a-b}{2}}{\sin \frac{a+b}{2}} \cot \frac{\gamma}{2}$$

$$\tan \frac{\alpha + \gamma}{2} = \frac{\cos \frac{a-c}{2}}{\cos \frac{a+c}{2}} \cot \frac{\beta}{2}$$

$$\tan \frac{\alpha - \gamma}{2} = \frac{\sin \frac{a-c}{2}}{\sin \frac{a+c}{2}} \cot \frac{\beta}{2}$$

$$\tan \frac{\beta + \gamma}{2} = \frac{\cos \frac{b-c}{2}}{\cos \frac{b+c}{2}} \cot \frac{\alpha}{2}$$

$$\tan \frac{\beta - \gamma}{2} = \frac{\sin \frac{b-c}{2}}{\sin \frac{b+c}{2}} \cot \frac{\alpha}{2}$$

$$\tan \frac{a + b}{2} = \frac{\cos \frac{\alpha-\beta}{2}}{\cos \frac{\alpha+\beta}{2}} \tan \frac{c}{2}$$

$$\tan \frac{a - b}{2} = \frac{\sin \frac{\alpha-\beta}{2}}{\sin \frac{\alpha+\beta}{2}} \tan \frac{c}{2}$$

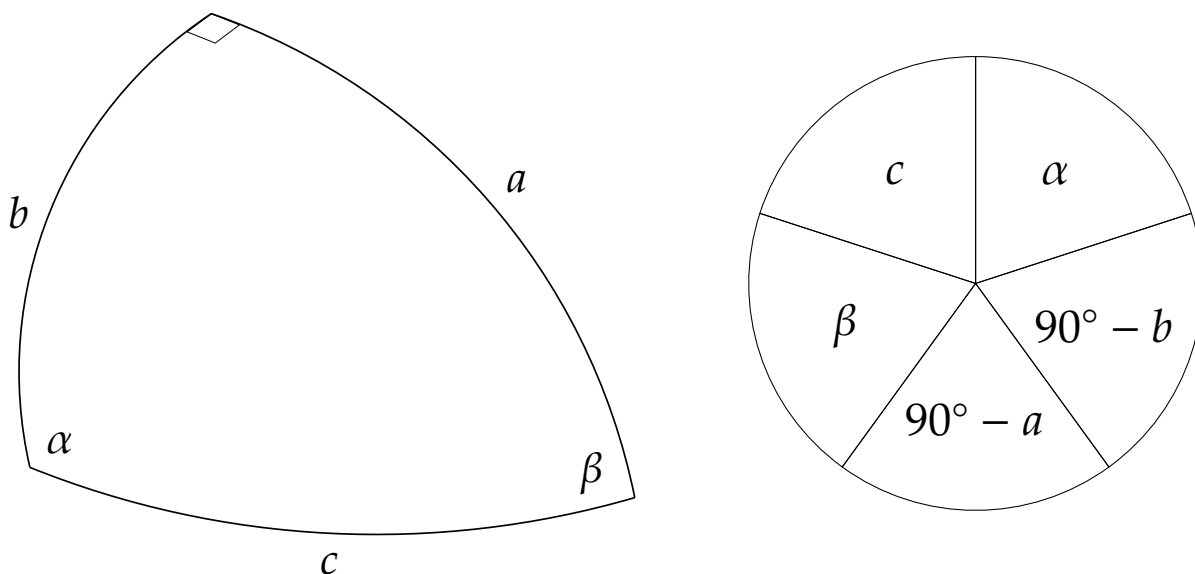
$$\tan \frac{a + c}{2} = \frac{\cos \frac{\alpha-\gamma}{2}}{\cos \frac{\alpha+\gamma}{2}} \tan \frac{b}{2}$$

$$\tan \frac{a - c}{2} = \frac{\sin \frac{\alpha-\gamma}{2}}{\sin \frac{\alpha+\gamma}{2}} \tan \frac{b}{2}$$

$$\tan \frac{b + c}{2} = \frac{\cos \frac{\beta-\gamma}{2}}{\cos \frac{\beta+\gamma}{2}} \tan \frac{a}{2}$$

$$\tan \frac{b - c}{2} = \frac{\sin \frac{\beta-\gamma}{2}}{\sin \frac{\beta+\gamma}{2}} \tan \frac{a}{2}$$

2 PRAVOKOTNI SFERNI TRIKOTNIK



Napierjevo pravilo

Kosinus izbranega elementa v "krogu" (shema zgoraj desno) je enak:

- i) produktu **kotangensov** sosednjih dveh elementov,
- ii) produktu **sinusov** nasprotnih dveh elementov.

Osnovna oblika izraza

$$\cos c = \cot \beta \cot \alpha$$

$$\cos c = \sin(90^\circ - a) \sin(90^\circ - b)$$

$$\cos \alpha = \cot c \cot(90^\circ - b)$$

$$\cos \alpha = \sin \beta \sin(90^\circ - a)$$

$$\cos(90^\circ - b) = \cot \alpha \cot(90^\circ - a)$$

$$\cos(90^\circ - b) = \sin c \sin \beta$$

$$\cos(90^\circ - a) = \cot(90^\circ - b) \cot \beta$$

$$\cos(90^\circ - a) = \sin \alpha \sin c$$

$$\cos \beta = \cot(90^\circ - a) \cot c$$

$$\cos \beta = \sin(90^\circ - b) \sin \alpha$$

Poenostavljena oblika izraza

$$\cos c = \cot \beta \cot \alpha$$

$$\cos c = \cos a \cos b$$

$$\cos \alpha = \cot c \tan b$$

$$\cos \alpha = \sin \beta \cos a$$

$$\sin b = \cot \alpha \tan a$$

$$\sin b = \sin c \sin \beta$$

$$\sin a = \tan b \cot \beta$$

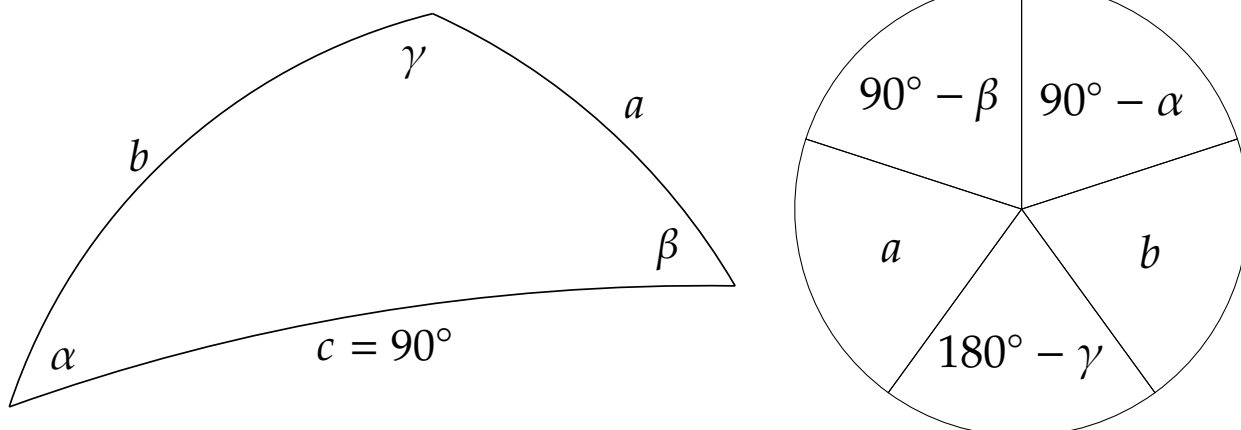
$$\sin a = \sin \alpha \sin c$$

$$\cos \beta = \tan a \cot c$$

$$\cos \beta = \cos b \sin \alpha$$

OPOMBA: Vsi poldnevnik sekajo ekvator pod pravim kotom.

3 PRAVOSTRANIČNI SFERNI TRIKOTNIK



Napierjevo pravilo

Kosinus izbranega elementa v "krogu" (shema zgoraj desno) je enak:

- i) produktu **kotangensov** sosednjih dveh elementov,
- ii) produktu **sinusov** nasprotnih dveh elementov.

Osnovna oblika izraza

$$\cos(90^\circ - \alpha) = \cot(90^\circ - \beta) \cot b$$

$$\cos(90^\circ - \alpha) = \sin a \sin(180^\circ - \gamma)$$

$$\cos b = \cot(90^\circ - \alpha) \cot(180^\circ - \gamma)$$

$$\cos b = \sin(90^\circ - \beta) \sin a$$

$$\cos(180^\circ - \gamma) = \cot b \cot a$$

$$\cos(180^\circ - \gamma) = \sin(90^\circ - \alpha) \sin(90^\circ - \beta)$$

$$\cos a = \cot(180^\circ - \gamma) \cot(90^\circ - \beta)$$

$$\cos a = \sin b \sin(90^\circ - \alpha)$$

$$\cos(90^\circ - \beta) = \cot a \cot(90^\circ - \alpha)$$

$$\cos(90^\circ - \beta) = \sin(180^\circ - \gamma) \sin b$$

Poenostavljena oblika izraza

$$\sin \alpha = \tan \beta \cot b$$

$$\sin \alpha = \sin a \sin \gamma$$

$$\cos b = -\tan \alpha \cot \gamma$$

$$\cos b = \cos \beta \sin a$$

$$\cos \gamma = -\cot b \cot a$$

$$\cos \gamma = -\cos \alpha \cos \beta$$

$$\cos a = -\cot \gamma \tan \beta$$

$$\cos a = \sin b \cos \alpha$$

$$\sin \beta = \cot a \tan \alpha$$

$$\sin \beta = \sin \gamma \sin b$$