Mini-Exam: Geodesy and Positioning (GIS-E1010) 22.10.2018

(Calculator. $\pi = 3.14159265358979$. $\sqrt{2} = 1.41421356237310$.)

1. Fundamentals

(a) [1p] The flattening of the Earth. How does the internal distribution of the Earth's masses affect her flattening? Newton's and Huygens' ideas and modern understanding.

(b) [1p] What is the asthenosphere, and what is the lithosphere? How do they differ?

(c) [1p] Polar motion and length-of-day (LOD) variations. How do they behave and what causes them, as well as available observation techniques.

(d) [1p] Explain how a hyperbolic positioning system like Decca functions.

2. Statistics, units

(a) [1p] Would you expect that the incidence of bush fires in Australia and the thickness of snow cover in Lapland would be correlated? Anticorrelated? Uncorrelated? Why?

(b) [1p] Convert $56°.7925$ to degrees, minutes and seconds.

(c) [1p] Convert $51°15'25''$ to gon.

(d) [1p] Convert 1.4545 radians to degrees.

3. Measurement instruments and methods

(a) [1p] The observation equation for code based pseudo-ranges is

$$p = \rho + c\,(\Delta T - \Delta t) + d_{\text{ion}} + d_{\text{trop}},$$

in which

$$\rho = \sqrt{(x - X)^2 + (y - Y)^2 + (z - Z)^2}.$$

Explain the meanings of the symbols appearing in the equations.

(b) [1p] The Helmert or similarity transformation in the plane can be given as

$$\begin{bmatrix} x \\ y \end{bmatrix} = K \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \cdot \begin{bmatrix} u \\ v \end{bmatrix} + \begin{bmatrix} x_0 \\ y_0 \end{bmatrix},$$

Explain the meanings of the symbols appearing in the equation.

(c) [1p] Explain the orbit data transmitted by the GPS satellites themselves (*broadcast ephemeris*) and so-called *precise ephemeris*. How are the latter disseminated to the users?

(d) [1p] Explain the idea behind the GOCE mission. GOCE = Gravity Field and Steady-State Ocean Circulation Explorer.

Grade (12 p = 100%)

$$\text{Grade} = 1 + 8 \times (\text{Exam} - 50\%) + 4 \times (\text{Exercises} - 50\%)$$

A minimum of 50% is required for both exam and exercises.