Kungl Tekniska Högskolan
Geodesi och satellitpositionering
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Written examination in
AG1817 / AG2926 Map projections and reference systems

To pass this exam, one should obtain at least 10 points out of 20 points in total

1. Ellipsoidal geodesy (5p)

1a. Define the first eccentricity e and second eccentricity e' ? If e is given, derive e' . (1p)

1b. Briefly define the basic geodetic problems on the reference ellipsoid. (2p)

1c. Why are many national triangulation systems not geocentric ? (2p)

2. Map projections (7p)

2a. Briefly describe map projection system UTM . (2p)

2b. Equidistant azimuthal projection for a sphere of radius R has following projection coordinates:

$$x = -R\,(\frac{\pi}{2} - \overline{\phi})\,\cos\lambda$$

$$y = +R\,(\frac{\pi}{2} - \overline{\phi})\,\sin\lambda$$

where $\overline{\phi}$, λ denote geocentric latitude and longitude. For this projection, find out : (5p)

a. the first fundamental coefficients e, f, g
b. the scale factor h of the meridian and the scale factor k of the parallel circle
c. the angle θ' between the projections of the meridian and parallel circle
d. the area scale factor ξ
e. Is this projection conformal or equivalent ?

3. Geodetic reference systems (8p)

3a. What is CIO ? What is the role of CIO for defining geodetic reference systems ? (2p)

3b. What is $J2000.0$? What is the role of $J2000.0$ for defining geodetic reference systems ? (2p)

3c. Assume that geodetic coordinates (ϕ, λ, h) have been determined in *SWEREF 99*. Outline the computational procedures (steps) to calculate map projection coordinates (x, y) in *RT 90*. If a computation step involves the use of a reference ellipsoid, specify which reference ellipsoid should be used. Detailed formulas are not required. (4p)

First fundamental form coefficients

$$
\begin{aligned}
e &= \left(\frac{\partial x}{\partial \overline{\phi}}\right)^2 + \left(\frac{\partial y}{\partial \overline{\phi}}\right)^2 \\
f &= \frac{\partial x}{\partial \overline{\phi}}\,\frac{\partial x}{\partial \lambda} + \frac{\partial y}{\partial \overline{\phi}}\,\frac{\partial y}{\partial \lambda} \\
g &= \left(\frac{\partial x}{\partial \lambda}\right)^2 + \left(\frac{\partial y}{\partial \lambda}\right)^2
\end{aligned}
$$

Special trigonometric functions

$$
\begin{cases}
\sin 0 = 0 & \sin 90^0 = 1 \\
\cos 0 = 1 & \cos 90^0 = 0 \\
\tan 0 = 0 & \tan 90^0 = \infty \\
\cot 0 = \infty & \cot 90^0 = 0
\end{cases}
$$