

Department of Geodesy and Surveying

Theory and Application of GNSS

BMEEOAFMF-1

Detailed course plan for the Spring semester in 2025

Lecturer: Szabolcs Rózsa, DSc, professor, (rozsa.szabolcs@emk.bme.hu)

Practicals: Bence Ambrus, MSc, teaching assistant, (ambrus.bence@emk.bme.hu)

Lecture 1 Feb 10 Sz.R.	Satellite positioning. Coordinate systems. Physics of satellite motion. Global navigation satellite systems (NAVSTAR GPS, GLONASS, Galileo, Beidou, etc.). The history of global positioning and navigation systems.
Practical 1 Feb 10 B.A.	Introduction of practicals. Coordinate systems (geographical, cartesian, Earth-centered Earth fixed, horizontal), transformations between coordinate systems. (HW1: transformations between reference systems)
Lecture 2 Feb 17 Sz.R.	Reference systems (WGS-84, ITRS, ETRS, etc.). GNSS time systems. The coordinates of the satellites at the epoch of the observation (orbit calculation and orbit integration). Standard file formats of ephemerides: RINEX NAV and SP3.
Lecture 3 Feb 24 Sz.R.	The GNSS signal structure. Observation signals and navigation messages. The principle of code and phase observations. Absolute and differential positioning using pseudoranges.
Practical 2 Feb 24 B.A.	Computation of satellite positions from almanach. Prediction of satellite geometry. Observation planning. (HW2: Assignment of the topics of student presentations)
Lecture 4 Mar 3 Sz. R.	Standard data and file formats of GNSS observations and coordinate solutions. (RINEX, SINEX, SP3, RTCM, NMEA). GNSS data warehouses. The International GNSS Service and its services.
Lecture 5 Mar 10 Sz. R.	Error sources of satellite positioning – 1: orbit and clock error, relativistic effects, effect of satellite geometry. Systematic effects in signal propagation: the effect of ionosphere, ionospheric corrections.
Practical 3 Mar 10 B.A.	Computation of satellite positions from broadcast ephemerides. (HW3: orbit computation).
Lecture 6 Mar 17 Sz.R.	Error sources of satellite positioning – 2: Systematic effects of signal propagation: the effect of the neutral atmosphere, tropospheric corrections. Error sources related to signal reception (cycle slips, phase center offset and variation, multipath).
Lecture 7 Mar 24 Sz.R.	GNSS positioning techniques. Properties of static and kinematic observations. Post-processed and realtime positioning techniques.





Practical 4 Mar 24 B.A.	<i>Computation of ionospheric and tropospheric effects.</i> (<i>HW4 Computation of propagation error</i>)
Lecture 8 Mar 31 Sz.R.	Processing phase observations. Precise Point Positioning. Linear combinations of observations and their applications.
Lecture 9 Apr 7 Sz. R.	Relative positioning using phase observations. The principle of differentiation. Phase ambiguities and their resolution: the integer least squares problem. Mathematical solution of positioning.
Practical 5 Apr 7 B.H.	Calculation of absolute positioning using pseudoranges (SPP - single point positioning). (HW5: Calculation of single point positioning)
Lecture 10 Apr 14 Sz. R.	Transformation of 3D cartesian coordinates to separated horizontal and vertical reference systems. The generations of the national and international GNSS infrastructure. GNSS Augmentation Systems. State Space Representation vs. Observation Space Representation.
Lecture 11 Apr 28 Sz.R.	GNSS Integrity. Safety-of-life applications.
Practical 6 Apr 28 Sz.R.	Precise GNSS observation processing. Introduction to the Bernese GNSS Software. Data acquisition, preprocessing, orbit determination.
Lecture 12 May 5 Sz.R.	Assessment 1: Assessment from the topics discussed in Lectures 1-11.
Lecture 13 May 12 Sz.R.	Future trends in GNSS positioning and their applications (e.g. precise orbit determination, atmospheric remote sensing, radiooccultation, etc.)
Practical 7 May 12 B.A.	Precise GNSS observation processing. Receiver clock synchronization, preprocessing and screening of phase observations, float solution, phase ambiguity resolution techniques, network adjustment.
Lecture 14 May 19 Sz.R.	Applications of GNSS: geodesy, surveying, geodynamics, geophysics, meteorology, Earth observation. Students' presentations (HW2)

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> Prof. Szabolcs Rózsa Lecturer

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