Course unit English denomination	Geomatics methodologies for acquisition, processing and manipulation of 3-D data
Teacher in charge (if defined)	Massimo Fabris
Teaching Hours	24
Number of ECTS credits allocated	3
Course period	From January 27 to February 6
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (70% minimum of presence) ☐ No
Course unit contents	Introduction in Geomatics (principles of Topography, Cartography and GNSS). Acquisition of 3-D data Photogrammetry: terrestrial, aerial and satellite acquisitions. Mathematical relationships between image and object spaces. Measurement and correction of image coordinates. Image matching algorithms, structure from motion, aerial triangulation. Stereo-model generation and error analysis. LiDAR: working principles. TLS (Terrestrial Laser Scanning) and ALS (Airborne Laser Scanning). Time Of Flight versus phase measuring systems. Data management, full waveform data Interpretation. Characteristics of instruments and sensors. UAV systems. Co-registration of 3-D data in Local or Global reference systems. Georeferencing. Surface representation Digital Terrain Modelling (DTM, DEM, DSM, DTMM) concepts and their implementation and applications in geomatics engineering and other disciplines. Emphasis will be on mathematical techniques used in the acquisition (e.g. photogrammetric data capture, digitized cartographic data sources capturing, other methods: InSAR, and LiDAR) processing, storage and manipulation of digital models. Models of DTM (Grids, Contours, and TINS), interpolation and extrapolation. Surface representation from point data using moving averages, linear projection, and Kriging techniques. Grid resampling methods and search algorithms used in gridding and interpolation. Applications DTM derivatives (slope maps, aspect maps, viewsheds and watershed maps). Filtering algorithms for feature, edge, contour extraction. Applications of DTM in volume computation and drainage networks. Multi-temporal and multi-resolution DTM, DEM, DSM, DTMM: integration, interpolation and co-registration for monitoring applications. Geomorphological operations and classification. Image rectification and orthophotos generation. Monitoring of damaged buildings and infrastructures. Monitoring of landslides, land subsidence, coastal erosion and evaluation of hydro-geological risks with geomatics data. Applications in the field of architectural representations and Cultural Heritage.
Learning goals	Acquisition of skills to perform three-dimensional surveys of objects or surfaces using sensors (such as photogrammetric cameras and laser scanners) housed on various platforms (ground, drone, helicopter, airplane, ...).

	Ability to manage three-dimensional point clouds for the extraction of digital models of surfaces and to perform operations between the obtained 3D models. Acquisition of skills to use the products extracted from the survey for studies aimed at knowledge and representation in the architectural and cultural heritage fields as well as for monitoring the deformations of infrastructures, landslide areas, subsiding areas, coastal areas.
Teaching methods	Frontal lessions and practical exercises
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	
Examination methods (in applicable)	Oral examination
Suggested readings	Notes from lessions and powerpoint presentations
Additional information	