Code: ICAR/06	**Credits: 6**
Matter: Geomatics	
Main language of instruction: Italian	
Other language of instruction: English	

Teaching Staff

Head instructor
Prof. Francesca Giannone - francesca.giannone@unicusano.it

Introduction
   1. *Objective of the course:*
The course "Geomatics" aims to give students a good knowledge of photogrammetry, remote sensing application, numerical cartography (CN) and basic applications in GIS - Geographic Information System software, with particular attention to the computational aspects concerning georeferencing and management of Italian numerical cartography.

Objectives

   2. *Course Structure:*
The course is organized in three modules. The first module is focused on photogrammetry: photogrammetry principles, orientation parameters and stereoscopic model, collinearity equations, characteristics of metric cameras and aerial photogrammetry.
The second module is focused on basic knowledge of Remote Sensing: main characteristics of remote sensing images, orthorectification of high-resolution satellite images, multispectral satellite mission (Sentinel2), basic skills in image processing and analysis of remote sensing data from satellites using SNAP software and GEE cloud platform. The knowledge acquired in theory lessons will be applied in the "virtual classroom" forum through one activity (E-tivity).
The third module is focused on numerical cartography managed in QGIS software: geodesy and Italian cartography; INSPIRE directive and cartographic services of IGMI-Istituto Geografico Militare Italiano; vector and raster data; Digital Elevation and Surface Model (DEM e DSM). Furthermore, basic tools for carrying out data

processing in a GIS environment (using open-source software QGIS) are presented. The knowledge acquired in theory lessons will be applied in the "virtual classroom" forum through three activities (E-tivity).

Competencies:

- knowledge of photogrammetry principles.
- knowledge of remote sensing principles.
- knowledge and use of SNAP software and GEE cloud platform
- knowledge and use of national numerical cartography.
- knowledge and use of georeferencing algorithm.
- knowledge of digital model
- knowledge and use of basic QGIS function.
- ability to use appropriate scientific terminology.

Syllabus

3. *Programme of the course:*

Subject 1. Photogrammetry

Proposed topics: photogrammetry, central projection, stereoscopic model, the orientation parameters: internal, external, relative and absolute orientation. Collinearity equations; stereoscopic restitution: normal case. Classification of cameras, geometric and radiometric resolution, digital cameras. Characteristics of metric cameras. Aerial photogrammetry: aerial photogrammetric cameras, flight plan parameters, bundle adjustment.

Subject 2. Remote sensing

Proposed topics: Introduction to Remote Sensing, atmospheric effects: radiance and reflectance. Orbit characteristics of satellite platforms. Characteristics of remote sensed images: geometric, radiometric, spectral and temporal resolution. Orientation and orthorectification of high-resolution satellite images, precision and accuracy analysis of orthorectified image. Thematic analysis, band algebra and indices, applications in the GEE or SNAP environment.

Subject 3. Numerical cartography and basic GIS tools

Proposed topics: geodesy and traditional cartography, Geoid, Ellipsoid, Coordinate systems, definition of main DATUM used in Italy, main projections, Gauss-Boaga cartographic systems, UTM-WGS84-ETRF89, UTM-ED50, EPSG code. Numerical cartography - description of raster and vector numerical cartography. Raster: structure and file type, geometric and radiometric resolution. Vector format: geometric elements and attributes. Products, services and EU INSPIRE directive: cartographic products and services of IGMI-Istituto Geografico Militare Italiano;

cartographic products available at regional level; INSPIRE directive and products of "Geoportale Nazionale": WCS, WMS, WFS and coordinate conversion services.

GIS software for CN management (basic operations). Georeferencing of raster files: standard geometric transformation; resampling algorithm (Nearest Neighbor, Bilinear and Cubic interpolation). Datum and coordinate transformations. DTM (Digital Terrain Model), DEM (Digital Elevation Model), DSM (Digital Surface Model). Digital models in TIN (Triangulated Irregular Network) and GRID (regular grid) format. Geomatic techniques to produce digital models and accuracy levels.

Evaluation system and criteria

The exam consists of a written test and four E-tivities carried out during the course in virtual classes.

The written test includes 3 theoretical questions on the main topics covered in the course.

During the written test, it is NOT allowed to use handouts, notes, texts or forms.

Bibliography and resources

4. Materials to consult:
The educational materials (lecture notes, slides and video lessons) are available on the Unicusano platform.

5. Recommended bibliography:
Kraus, Karl, **"photogrammetry: geometry from images and laser scans"**, de Gruyter

Siamak Khorram, Cynthia F. van der Wiele, Frank H. Koch, Stacy A. C. Nelson, Matthew D. Potts **"Principles of applied remote sensing"** Springer

Peter A. Burrough, Rachael A. McDonnell and Christopher D. Lloyd **"Principles of Geographical Information Systems"**, Oxford University Press