

## 386SM – GEOGRAPHIC INFORMATION SYSTEMS

### Aims

Knowledge and practical skills relative to numerical cartography and GIS applications.

### Contenuti

Principal elements of Geodesy and Cartography: Reference Systems, DATUMs, principal Coordinate Systems, Cartographic Projections and transformations between different reference systems. IGM (Italian Military Geographic Institute) and CTRN (Friuli Venezia Giulia Region Numeric Cartography).

Geographic Information Systems (GIS) and Territorial Systems (SIT): definitions, standard and norms, relations with traditional cartography, georeferencing, vector and raster formats, nominal scale and resolution, entity, attribute, spatial and not spatial queries, topology, layer, themes.

Innovative 3D surveying techniques of numeric georeferenced data:

- Integrated electronic topographic instruments (integrated electronic theodolites, EDM, high accuracy optical and electronic levelling instruments).
- Terrestrial and aerial digital Photogrammetry – fundamentals and applications to numeric cartography.
- Integrated GNSS techniques - pseudorange and interferential GNSS observables: static, rapid-static, Stop&Go, kinematic post-processing and real-time surveys; applications. EGNOS (European Geostationary Navigation Overlay Service) applications to terrestrial, maritime and aerial navigation. Practical lessons on L1/L2 GPS+GLONASS/EGNOS surveys.
- Laser scanning – fundamentals and applications to civil engineering structures survey and environmental monitoring. Innovative applications to archaeology and architecture.
- Remote sensing: principal sensors (Spot, Landsat, ERS, SAR, etc.) and applications to environmental pollution monitoring, natural resources and land use.

Structure of geographic-numeric data. Relational database applied to GIS. Geodatabases.

Informatic architecture: database alphanumeric cartographic database, relations between entity and records, vector and raster format. Raster/vector and vector/raster transformations.

Numeric cartography. Friuli Venezia Giulia CTRN: layers, accuracies, code and standard.

Digitalization and scanning. Data simplification and aggregation.

Digital Terrain Models/Digital Elevation Models (DTM, DEM). Interpolation techniques, IDW technique. TIN models and their characteristics.

Examples of GIS e WebGIS applications. ESRI ArcGIS commercial software. MAPServer. Principali opensource platforms (QuantumGIS, gvSIG, GRASS, SAGA GIS).

UAVs (Unmanned Aerial Vehicles) for terrestrial and environmental surveys – applications to GIS applications to waste management.

Practical lessons on PC: relational database, links, queries, buffer generation, overlay, editing, thematic maps. Applications using ArcGIS software (ArcMap, ArcCatalog, ArcToolbox, ArcScene with 3D Analyst extensions) and open source software.

Students will implement (alone or in groups of 2-3 persons) a GIS application (using commercial or open source software), with a geodatabase built by them or given by the teacher.

During the Course practical lessons on the field will be given using integrated instruments (GNSS/Laser scanning), technical Seminars, technical visits at private and public firms.

Live demonstrations of advanced instruments (GNSS/robotic total stations/Laser scanners) will be organized in cooperation with manufacturers (Leica Geosystem, Geotop)

### **Teaching format**

Theoretical and practical lessons on dedicated Pcs in GIS Room.

Seminars on innovative topics included in the Programme.

Live instruments demonstrations.

### **Assessment**

Students will implement (alone or in groups of 2-3 persons) a project application (using commercial or opensource software). The exam will consist in the presentation of the project and some oral questions on the topics presented during the Course.