



National University of Engineering (UNI)

School of Civil Engineering

Syllabus 2027-I

1. COURSE

CE2T2. Applied Geomatics (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: CE2T2. Applied Geomatics
2.2 Semester	: 7 th Semester.
2.3 Credits	: 4
2.4 Hours	: 3 HT; 2 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Mandatory
2.7 Learning modality	: Face to face
2.8 Prerequisites	: CE2T1. Basic Geomatics. (6 th Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Applied Geomatics extends the ground-survey fundamentals established in Basic Geomatics (Surveying I) – measurement theory, planimetry, leveling, and total-station operation – into the advanced field applications a civil engineer uses throughout a project's life cycle. The course opens with the general considerations and feasibility-stage surface information a civil works project requires, then develops how topographic mapping techniques (contour-based gradient-line analysis, route alignment, and preliminary route evaluation) support planning decisions and feed digital terrain models into Building Information Modeling (BIM) workflows. It then returns to the control-network techniques that make all subsequent surveying consistent and reliable: trigonometric leveling, least-squares network adjustment, classical triangulation/trilateration, and modern GNSS static and Real-Time Kinematic (RTK) positioning. The course next covers the construction-stage application of total-station surveying to stake out horizontal alignments, points of inflection, curves, and grade lines, together with the planning and budgeting of a topographic field campaign. It closes with specialized surveying applications for bridges, tunnels, and water-resources works – bathymetric surveys and reservoir/impoundment volume computations – building on the earthwork volume methods covered earlier. Because photogrammetry, Geographic Information Systems (GIS), and satellite-derived geospatial information are each the subject of their own dedicated course later in the curriculum (Geodesy in CE2T3, Photogrammetry in CE3T1, GIS in CE3T3), this course introduces them only briefly, as a preview of the broader geospatial-information toolchain a civil engineer will use.

5. GOALS

- Apply error theory and least-squares adjustment to establish reliable horizontal and vertical control networks, combining classical methods (triangulation/trilateration, trigonometric leveling) with modern GNSS positioning.
- Produce the topographic mapping and digital terrain models a civil works project needs at the feasibility and planning stages, including gradient-line analysis and route evaluation, and integrate them into BIM workflows.
- Collect field data using GNSS static/RTK and total-station instruments appropriate to a given project's accuracy requirement.
- Stake out horizontal alignments, points of inflection, curves, and grade lines using total-station methods, and verify as-built geometry against the design.
- Plan and budget a topographic field survey campaign for a civil works project.
- Compute earthwork and reservoir/impoundment volumes from specialized surveys (bridges, tunnels, bathymetry), and recognize how photogrammetry, GIS, and satellite-derived geospatial data extend these techniques.

6. COMPETENCES

ABET-1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (Usage)

ABET-2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. (Usage)

ABET-6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (Usage)

7. TOPICS

Unit 1: Topographic Mapping and Digital Terrain Models (30 hours)	
Competences Expected: ABET-1,ABET-2	
Topics	Learning Outcomes
- Contour representation and interpretation of terrain relief - Digital Terrain Model (DTM) generation from field or GNSS survey data - Topographic map production and cartographic conventions	- Generate a contour map from field survey data [Usage] - Build a digital terrain model (DTM) from a point-based topographic survey [Assessment]
Readings : [GhilaniWolf2015], [SchofieldBreach2007]	

Unit 2: GNSS Surveying (15 hours)	
Competences Expected: ABET-1,ABET-6	
Topics	Learning Outcomes
- GNSS positioning principles: satellite constellations, signals, and error sources - Static and Real-Time Kinematic (RTK) GNSS surveying methods - Coordinate reference systems and datum transformations for GNSS data	- Compare static and RTK GNSS surveying methods and identify which fits a given accuracy requirement [Familiarity] - Transform GNSS-derived coordinates between reference datums for use in a local project [Usage]
Readings : [LeickRapoportTatarnikov2015], [GhilaniWolf2015]	

Unit 3: Construction Layout and Stakeout Surveying (15 hours)	
Competences Expected: ABET-2,ABET-6	
Topics	Learning Outcomes
- Stakeout methods for horizontal and vertical alignment of civil works - As-built survey verification against design geometry	- Stake out a horizontal alignment (e.g. a road centerline or building corner) from design coordinates [Usage] - Verify as-built construction geometry against design specifications using survey data [Assessment]
Readings : [SchofieldBreach2007], [Kavanagh2014]	

Unit 4: Earthwork Volume Computations (10 hours)	
Competences Expected: ABET-1,ABET-6	
Topics	Learning Outcomes
• Cut and fill volume computation methods: average end area and prismatical • Mass-haul diagrams for earthwork balance and haul distance planning	• Calculate cut and fill volumes for a linear earthwork project from cross-section data [Usage] • Construct a mass-haul diagram to plan earthwork balance and haul distances [Usage]
Readings : [GhilaniWolf2015], [UrenPrice2010]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY