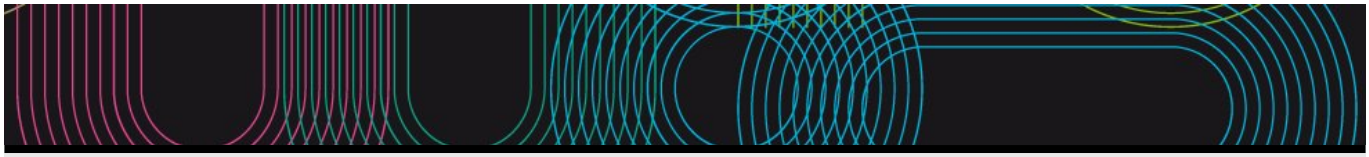

IDENTIFYING DATA				
Basics of topography				
Subject	Basics of topography			
Code	P52G381V01410			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Puente Luna, Iván			
Lecturers	Puente Luna, Iván			
E-mail	ipuente@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The course of Basics of Topography is composed of a total of seven units (theoretical teaching) that are complemented with practical classes. Depending on the objectives of the units, this course is divided into two different sections: - Section I: Topography. Composed of four units including basics aspects of topography, preparation of plans and their application to land works. - Section II. Other geomatic techniques. Composed of three units, including complementary techniques most commonly used for the recognition and representation of the terrain.			

Training and Learning Results	
Code	
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
B5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
C42	CITN16/OPT12 The level of topographic skills to trace and follow trails over unknown terrain
C43	CITN17/OPT13 Acquire knowledge of topography and its application to the representation of the land and works.
D2	Problems resolution.
D3	Oral and written proficiency
D7	Ability to organize and plan.
D8	Decision making.
D9	Apply knowledge.
D10	Self learning and work.
D17	Team working.
D20	Ability to communicate with people not expert in the field.

Expected results from this subject	Training and Learning Results		
To know the technological base on which the topography and elaboration of plans are based.	B3 B4 B5	C42 C43	D2 D3 D7 D8 D9 D10 D17 D20

To understand the basic aspects of the application of Topography to land works.	B3 B4	C42 C43	D2 D9
To know other complementary geomatic techniques for the recognition and representation of the land.	B3 B4 B5	C42 C43	D2 D3 D7 D8 D9 D10
ENAEE learning outcome: KNOWLEDGE and UNDERSTANDING: LO1.2.- knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].	B3		
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.2.- ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical societal, health and safety, environmental, economic and industrial constraints [Intermediate (2)].	B4		D2 D8 D9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.1.- understanding of applicable techniques and methods of analysis, design and investigation and of their limitations in their field of study [Intermediate (2)].			D9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	B4 B5		D2 D9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.3.- understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study [Intermediate (2)].		C42 C43	D8 D9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [Intermediate (2)].	B4		D3 D20
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].			D7 D8 D10 D17

Contents

Topic	
Unit 1. Introduction to Topography. Objectives: to update and review the concepts acquired by the students in the previous subjects of Topography within the specific military training. To consolidate a scientific knowledge of the basics of Topography.	1.1 Definitions. Relation of Topography with other sciences. Geodesy and Topography. Shape of the Earth: geoid and ellipsoid. Geodesic methods. Geodesic reference systems. Datum or fundamental astronomical point. Base and geodesic triangulation. Geodesy by satellite. Limit of a topographic survey. Influence of the Earth curvature in planimetry and altimetry. 1.2 Graphic representation systems. Projections. Orthogonal projection and system. Graphic representation of the terrain. Maps, charts and planes. Graphic and numerical scales. Triangulation, geodesic and topographic networks. 1.3 Cartography. Cartographic projections. Deformations and local scale. Classification of the projections. Mercator's Projection. UTM Projection. UTM grid. 1.4 Coordinates: Cartesian and polar coordinates. Geographic coordinates. Transformation of coordinates. Lines and distances. Concept of geodesic line. Angles and alignments. The terrestrial magnetic field. Magnetic declination. Magnetic and grid azimuths.
Unit 2. Instruments and systems used in Topography. Objectives: To identify and know the different instruments and systems commonly used in Topography. To acquire the necessary ability and skills for a basic management of real Topographic equipment to be used by the students during the practical sessions of the subject.	2.1 Topographic observations. Uncertainty and errors in Topography. General concepts of geometrical optics. Optical instruments. Prisms and lens. Telescopes. Topographic telescope. 2.2 Auxiliary Topographic elements: tripods, levels, platforms for levelling, plummets. Theodolites and tachymeters. Horizontal and vertical circles, vernier and micrometers. Goniometers. 2.3 Total Station. Operation of the Total Station. 2.4 Global Positioning System (GPS). Application of the GPS in geodesy and topography. 2.5 Units of measure: length, surface, angular units. Centesimal and sexagesimal systems. Transformation of units between systems. 2.6 Horizontal and vertical angles. Errors.

Unit 3. Topographic methods: planimetry and altimetry. Objectives: To know and apply the planimetric methods to properly represent a terrain into a flat surface. To know and apply the altimetric methods to properly represent the altitude and morphology of a terrain.	3.1 Planimetric methods. Method of abscissas and ordinates to an unique axis. Method of decomposition in triangles. Method of alignments. Method of radiation. Itinerary or poligonation. Method of intersections: direct and inverse intersection, mixed intersection, graphic and numerical solutions. 3.2 Altimetric methods. Levels and telescopic sights: description. Comparison plane: heights, differences of level and altitude. Trigonometric levelling. Geometrical levelling. 3.3 Digital Model of the Terrain (MDT). Contour lines. 3.4 Interpretation of planes. Visibility between two points in the terrain.
Unit 4. Applications of the Topography. Objectives: To be able to apply the theoretical and practical contents of the topography for the realisation of the different topographic works and its applications on construction as well as in other fields.	4.1 Topographic, cadastral and urban surveys. Topography in mining and tunnelling. Surveying for engineering projects. Design of a topographic project. 4.2 Profiles: longitudinal and transversal. Land movement: slope and land clearing. Civil work. Construction stakeout surveys. 4.3 Defensive organisation of the terrain. Construction of tracks and forest paths.
Unit 5. Introduction to Geomatic. Objectives: To know the different geomatic techniques for cartographic production.	5.1 Definition and fundamentals of the geomatic as source of data for cartographic production. 5.2 Introduction to long-range systems: spatial remote sensing. Landsat and Spot sensors. 5.3 Introduction to close-range systems: photogrammetry and LiDAR technology (aerial and terrestrial systems). 5.4 Introduction to the geophysical prospection: georadar and acoustic (sonar). Bathymetries.
Unit 6. Geographic Information Systems (GIS). Objectives: To know and apply the fundamentals of Geographic Information Systems, as well as the management of large amounts of cartographic and geographic data in different formats.	6.1 Concept of Geographic Information System (GIS). Differences between GIS, database and CAD. 6.2 Concepts about geographic and spatial information: data and metadata. Raster and vectorial models. Geoprocessing. Digitization and georeferencing of data. 6.3 Main applications of GIS for the management and planning of the territory. Military GIS. 6.4 Phases of a GIS project. Basic concepts of Thematic Cartography. 6.5 Cartographic data sources. Web GIS and Spatial Data Infrastructure (SDI).
Unit 7. Photogrammetry and its applications. Objectives: To know the techniques of the photogrammetry and its applications, both in civil and military fields. To understand the importance of the photogrammetry as a tool to produce maps and plans, as well as its utility for georeferencing a territory.	7.1 Aerial photogrammetry and its applications. The photography as a conical perspective. Types of aerial photographs. Aerial photography and plane: comparison. Photogrammetry. Generalities and definitions. Applications. The problem of the photogrammetry. Perspective beams. The aerial and the metric cameras. Internal data of the projective beams. Identification of homologous rays. External data of the projective beams. Control points. Intersection of homologous rays. Photogrammetric restitution. Accuracy of photogrammetric surveys. 7.2 The orthophoto. Close-range photogrammetry. Instruments and data acquisition: cameras. Measuring instruments. Methods. Applications: industrial photogrammetry, photogrammetry applied to civil engineering and architecture.
Practical Activity 1. First contact with topographic instrumentation.	Total Station and the measurement of areas.
Practical Activity 2. Planning a topographic survey in the field and design of a closed itinerary.	Method of itinerary in the field.
Practical Activity 3. Method of radiation in the field.	Acquisition of strategic and filling points.
Practical Activity 4. Elaboration of the point cloud and calculation of coordinates.	Generation of planimetry.
Practical Activity 5. MDT. Contour lines. Longitudinal and transversal profiles.	Generation of altimetry.
Practical Activity 6. Development of a GIS case study.	Geoprocessing and Thematic Cartography.
Practical Activity 7. Session dedicated to the presentation of the final projects.	Evaluation of the field project regarding the elaboration of a topographic survey.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	35	63
Field practice	6	6	12
Problem solving	7	7	14

Seminars	15	16	31
Practices through ICT	4	4	8
Project based learning	4	4	8
Essay questions exam	14	0	14

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	The lecturer will expose in the theoretical classes the contents of the subject. The presentations will be screened and the blackboard will be simultaneously used, as well as to the sporadically use of computerized systems. The student will have copies of the material projected, to facilitate them for taking notes and follow-up the sessions. The students will be able to consult basic bibliography for the follow-up of the subject. The participation will be encouraged through questions, motivational techniques such as intentional errors, incomplete solutions, etc.
Field practice	During the field sessions, the student will use topographic instrumentation in groups of 3-4, in order to learn the process of data acquisition. The students have to deliver, individually or as a group according to previous indication by the lecturer, the resolution of some practical case studies proposed at the end of each session. The lecturer will evaluate both the deliver of the proposed exercise as well as the results presented. If the report is delivered blank with the name of the student, it will be failed (0,0). If the report is a plagiarism of another one, the evaluation for all the practical section (outdoor study and Project) will be failed (0,0). These deliveries will serve to evaluate the phase of development of a topographic survey and data processing in the final Project. The lecturer will establish the deadline for each deliver at the end of the sessions, although it should not be extended more than two weeks from their realization.
Problem solving	The lecturer will propose activities to solve exercises related to the contents explained in the theoretical sessions, following a learning methodology based on problems.
Seminars	Intensive course (15 hours) for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer.
Practices through ICT	The practical sessions in the computer room will be carried out using the means available in the center. For some sessions, Topocal software will be necessary to manage different tools for the generation of plans and other concepts explained in the theoretical sessions, and AutoCAD software will be needed for the edition of plans. The software QGIS will be also used for the geospatial analysis of geographic data, as well as for the elaboration of thematic cartography.
Project based learning	The students have to submit, at the end of the semester, a final Project. This Project must include all the practical procedures carried out during the outdoor study in order to perform a topographic survey, the data processing in laboratory and the elaboration of the planimetric and altimetric planes. The Project will be carried out in group (3-4 students) and the results will be presented in both forms: (1) a Project report and (2) a public presentation to the lecturer and the rest of the students in the subject. The lecturer will evaluate both the content on the report and the quality in the presentation. All the students have to participate in the public presentation. Otherwise, the project assessment will be failed (0,0).

Personalized assistance

Methodologies	Description
Problem solving	The lecturer will solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, MooVi forums, etc.) with previous appointment.
Project based learning	The lecturer will solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, MooVi forums, etc.) with previous appointment.
Seminars	Group tutoring with the lecturer, either personally or through telematic means.

Assessment

	Description	Qualification	Training and Learning Results		
Lecturing	A mid-term exam, in a continuous assessment, to evaluate the knowledge acquired by the students in the theoretical sessions of initiation to the topography and topographic surveys.	15	B3 B4	C42 C43	D2 D8 D9
Problem solving	Practical tests of laboratory/seminar to evaluate the resolution of exercises or case studies and the implementation of the theoretical knowledge acquired.	15	B3 B4 B5	C42 C43	D2 D7 D9 D10

Project based learning	Project evaluation. The development of the project is evaluated, as well as the final report delivered, results and quality of the public presentation.	30	B3 B4 B5	C43	D2 D3 D7 D8 D9 D17 D20
Essay questions exam	A final exam, in a continuous assessment, covering all the contents of the subject.	40	B3 B4	C42 C43	D2 D8 D9

Other comments on the Evaluation

A numerical rating system with values from 0.0 to 10.0 points will be used according to current legislation (R.D. 1125/2003 of September 5, B.O.E. No. 224 of September 18). The subject will be considered passed when the student achieves a minimum qualification of 5.0 points.

The evaluation techniques of the subject will be:

- Final exam in continuous assessment (up to 40% of the total qualification): a final exam will be carried out covering all the contents of the subject, both theoretical and practical. It is required to achieve a minimum score of 4.0 points over 10 possible to pass the subject.
- Mid-term test in continuous assessment (up to 15% of the total qualification): An evaluation test will be carried out throughout the semester. The test will be carried out, proposed by the lecturer, at the most appropriate times within the theory classes of the subject. This test will be mandatory and required to pass the subject.
- Individual work based on a GIS case study (up to 15% of the total qualification): The students, individually, have to present a work based on a practical case study to be solved with GIS tools, including: purpose of the analysis, input data, analysis tools and / or geoprocessing, the results obtained and the thematic cartography elaborated.
- Development of a project (up to 30% of the total qualification): During the semester, the students have to develop a topographic survey in groups of 3-4 students. At the end of the semester, the students have to present the project in a public presentation. The presentation will be planned on the day and time previously communicated to the students and with the evaluation criteria previously indicated by the lecturer (evaluation rubric). All the students have to participate in the public presentation. Otherwise, the Project qualification will be 0.0 (failed).

Regarding the evaluation criteria and qualification of the project-based learning, the total score of the activity (30%) will be the sum of the following partial evaluations: project development (10%), content of the project report (10%) and contents and quality of the presentation (10%). In the project development, the delivery of the partial results of the project, which are obtained after each field session, will be taken into account. Both the delivery of documents and the calculation procedures and the correct resolution will be assessed. The deliveries have to be presented on time (except for properly justified reasons). Otherwise, the student will be qualified in this component with 0.0. The final qualification of this component will be reduced depending on the number of deliveries not presented on time.Those students who have not reached the minimum score in any of the qualifying tests in continuous assessment will obtain a maximum score of 4.5 in continuous evaluation.
All the students who have not passed the subject during the continuous evaluation will have the right to recover the subject in an ordinary call. Those students who wish to raise their score in continuous assessment may present this ordinary call, in which case the final exam will constitute 100% of the final score, being necessary to reach a minimum of 5.0 points to pass the subject. It is understood that the score obtained in the ordinary exam substitutes, if higher, the one obtained in the continuous evaluation.
Similarly, all the students who have not passed the subject during the first call will have the right to recover the subject in an extraordinary exam (second call). This exam will constitute 100% of the final score, being necessary to reach a minimum of 5.0 points to pass the subject.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centers for incorporation into the ranks of the Armed Forces*, **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity**, regardless of the porcentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

DOMÍNGUEZ M. Y BELDA M., **Topografía y sistemas de información geográfica.**, Universidad nacional de educación a distancia, 2003

LÓPEZ M.; MARTÍNEZ E. Y BLASCO J.J, **Topografía para estudios de grado: geodesia, cartografía, fotogrametría, topografía**, Bellisco, 2009

MUÑOZ C., **Problemas básicos de topografía. Planteados y resueltos.**, Bellisco, 2000

SÁNCHEZ A., **Problemas de métodos topográficos. Planteados y resueltos.**, Bellisco, 2015

Complementary Bibliography

DOMÍNGUEZ GARCÍA-TEJERO F., **Topografía general y aplicada**, Mundi-Prensa, 1992

FERRER R. Y PIÑA B., **Topografía aplicada a la ingeniería**, ETSICCP Universidad de Cantabria, 1992

CHUECA PAZOS M., **Topografía**, Dossat S.A., 1983

RUIZ MORALES M., **Problemas Resueltos de Geodesia y Topografía**, Comares, 1992

RUIZ MORALES M., **Nociones de topografía y fotogrametría aérea**, 2003

Recommendations

Subjects that continue the syllabus

Technical Office/P52G381V01501

Subjects that it is recommended to have taken before

Graphic engineering/P52G381V01304

Other comments

In order to successfully pass the subject, the student must consider the following recommendations:
1. A regular and active attendance to classes, both theoretical and practical.
2. To maintain a minimum daily study.

It is recommended that the student of the subject Basics of Topography have completed and passed previous subjects of design and spatial vision such as Graphic Expression and Graphic Engineering.
For the correct development of the theoretical classes, as well as laboratory and seminars sessions, it is recommended to have the basic calculation tools.