Course guide
2500018 - GECTECNREP - Representation Techniques

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Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: MARIO FERNANDEZ GONZALEZ

Others: ALBA CALVET SISÓ, MARIO FERNANDEZ GONZALEZ, SERGIO LOPEZ LAZARO, JORDI POBLET PUIG

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14393. Capacity for spatial vision and knowledge of graphic representation techniques, both by traditional methods of metric geometry and descriptive geometry, as well as by computer-aided design applications. (Basic training module)
14394. Basic knowledge about the use and programming of computers, operating systems, databases and computer programs with engineering application. (Basic training module)

TEACHING METHODOLOGY

The course consists of 2 hours per week of classroom activity (large size group) and 1.6 hours weekly with half the students (medium size group).

The 2 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.6 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

The language in which the activities will be taught in each group will be approximately as follows:
-English group: 100% in English.
-Group 10: 100% in Spanish language.
-Group 20: 30% in Catalan language and 70% in Spanish language.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of descriptive geometry II. The polyhedral figures, the surfaces and the dihedral intersections from the basic fundamentals of graphic expression. Representation systems and graphic design through specific programs of civil engineering.

1 Ability to solve complex geometry problems. 2 Ability to use computer-aided design programs in complex geometry problems.
3 Development capacity of multiview orthographic projections of complex geometry problems.

Complex traditional graphical representation knowledge (descriptive geometry) and applications of computer-aided design with engineering software. Knowledge of numerical geometry including the use of computer tools. Carrying out constructions in flat metric geometry. Application to stake out, renders and visualization in 3 dimensions. Knowledge of the dihedral system including homology, affinity, depressions, shadows, polyhedra, radiated surfaces, of revolution and ruled surfaces. BIM Laboratory. Basic concepts and use of the BIM software, application to the project of geometric surfaces proper to the descriptive geometry used in engineering and architecture

1.- Development of the capacity for abstraction from the representation of geometric surfaces, whether ruled (developable, warped) or curved. 2.- To give solution to the problems of the geometry of the space by means of operations carried out on a plane. 3.- Accurately represent geometric shapes and surfaces in 3D in space on two-dimensional projection planes. 4.- Be able to deduce and transfer to the three dimensions the exact description of these surfaces in 2D through the dihedral representation system and everything that necessarily follows from their shapes and their relative positions with respect to the projection planes 5. - To be able to represent on the plane the exact projections of bodies in space (geometric surfaces, whether ruled or curved), using the three basic projection planes of the dihedral system, thereby appreciating the universality of the descriptive geometry in transmission and understanding of all project documentation. 6.- Development of the student's spatial capacity through a process of spatial maturity, which allows him to reconstruct in the mind or materially the forms and surfaces given by his representations (dihedral projections), to put his creative faculty at the service of the future civil engineer. where geometry and spatial capacity play a vital role in the design of civil technical projects. In this way, the knowledge of the matter in its development and spatial maturity will give the engineer a double aspect: on the one hand, to become familiar with the management and representation of the treated geometric surfaces whose proper use may have the character of a civil project, and by another part that will provide the technique that will allow him to correctly represent the forms created by himself, so that they can be correctly interpreted from his representation by those who have to be in charge of their actual construction and materialization of the project.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	6,0	4.00
Guided activities	6,0	4.00
Hours medium group	24,0	16.00
Self study	84,0	56.00

Total learning time: 150 h

CONTENTS

DI_SP: Dihedral system: Polyhedral Surfaces

Description:
0.0.- Review of the fundamental operation of the dihedral system. 1.1. Definition, elements and representation. 1.2. Convex regular polyhedra (platonic solids) 1.3. Intersections and flat sections 1.4. Conjugated polyhedra 1.5. Semi-regular polyhedra (general) 1.6. Shadows Applied to Polyhedra
S1-2. Problems and exercises
2.1. Definition and description 2.2. Properties 2.3. Main section 2.4. Flat sections 2.5. Representations: - With one face in the horizontal plane - With one vertical edge - With two horizontal edges. 2.6. Shadows 2.7. problems
S2-2. Problems and exercises
3.1. Definition and description 3.2. Properties 3.3. Main section 3.4. Flat sections 3.5. Representations: - With one face in the horizontal plane - With two horizontal edges - With a vertical main diagonal 3.6. Shadows 3.7. problems
S3-2. Problems and exercises
4.1. Definition and description 4.2. Properties 4.3. Main section 4.4. Flat sections 4.5. Representations: - With one face in the horizontal plane - With two horizontal edges - With a vertical main diagonal 4.6. Shadows 4.7. problems
S4-2. Problems and exercises
5.1. Definition and description 5.2. Properties 5.3. Main section 5.4. Flat sections 5.5. Representations: - With a face in the horizontal plane - With an edge on the PH and with a main section perpendicular to the PH - With a vertical main diagonal 5.6. Shadows 5.7. problems
S5-2. Problems and exercises
6.1. Definition and description 6.2. Properties 6.3. Main section 6.4. Flat sections 6.5. Representations: - With a face in the horizontal plane - With an edge on the PH and with a main section perpendicular to the PH - With a vertical main diagonal 6.6. Shadows 6.7. problems
S6-2. Problems and exercises
7.1. Geodesic Domes 7.2. Folds 7.3. Spatial lattice structures
S7-2. Problems and exercises

Full-or-part-time: 50h 24m
Theory classes: 14h
Practical classes: 7h
Self study : 29h 24m

DI_SC: Dihedral System: Curved Surfaces

Description:
8.1. Projections of the sphere. 8.2. Section of a sphere by a horizontal plane and a vertical plane. 8.3. Projections of points located on the sphere. 8.4. Intersection of a horizontal line with a sphere. 8.5. Intersection of a line with a sphere. 8.6. Section of a sphere by a vertical plane. 8.7. Section of a sphere by a plane of edge. 8.8. Tangent plane to a sphere by a point on the surface. 8.9. Tangent plane to a sphere and passing through LT 8.10. Tangent plane to a sphere with a given direction. 8.11. Tangent planes to a sphere that contain an outer line. 8.12. Intersection of a sphere by an oblique plane (any) that passes through the center of the sphere. 8.13. Proper and cast shadow of a sphere on the projection planes. 8.14. problems
S8-2. Problems and exercises

Full-or-part-time: 7h 11m
Theory classes: 2h
Practical classes: 1h
Self study : 4h 11m

DI_SR: Dihedral system: Radiated surfaces

Description:
9.1. Developable 9.1.1. Definition and classification. 9.2. Prism 9.2.1. Representation. 9.2.2. Situation of a point on the prism. 9.2.3. Intersection of the prism with a line. 9.2.4. Intersection of the prism with a plane. 9.2.5. Prism development. 9.3. Pyramid 9.3.1. Representation. 9.3.2. Location of a point on the pyramid. 9.3.3. Intersection of the pyramid with a line. 9.3.4. Intersection of the pyramid with a plane. 9.3.5. Development of the pyramid.
S9-2. Problems and exercises
9.4. Cone 9.4.1 Representation. 9.4.2 Location of a point on the cone. 9.4.3 Intersection of the cone with a line. 9.4.4 Development of the cone. 9.4.5 Plane sections and true magnitude: - Circumference, ellipse, parabola and hyperbola 9.4.6 Tangent planes to the cone: - By a point on the surface. - By a point outside the surface. - Tangent planes to a given direction.
S10-2. Problems and exercises
9.5. Cylinder 9.5.1 Representation. 9.5.2 Location of a point on the cylinder. 9.5.3 Intersection of the cylinder with a line. 9.5.4 Cylinder development. 9.5.5 Flat sections and true magnitude: - Circumference. - Ellipse. 9.5.6 Tangent planes to the cylinder: - By a point on the surface. - By a point outside the surface. - Tangent planes to a given direction.
S11-2. Problems and exercises

Full-or-part-time: 21h 36m
Theory classes: 6h
Practical classes: 3h
Self study : 12h 36m

DI_ISR: Dihedral system: Surface intersections

Description:
10. Intersection of radiated and revolution surfaces. 10.1. Intersection of two surfaces, whose bases are contained in the same projection plane: - Two pyramids, two prisms, two cones, two cylinders. - Cone - pyramid, cone - cylinder, cone - prism. - Cylinder - pyramid, Cylinder - prism and pyramid - prism.
S12-2. Problems and exercises
10.2. Intersection of two surfaces, whose bases are contained in different projection planes. 10.3. Intersection of two surfaces where one of them is defined by horizontal edges / generatrices.
S13-2. Problems and exercises
10.4. Intersection of two surfaces of revolution 10.5. problems
S14-2. Problems and exercises

Full-or-part-time: 21h 36m
Theory classes: 6h
Practical classes: 3h
Self study : 12h 36m

L_BIM: BIM Laboratory (parametric software)

Description:
During this practical part of the course, concepts and methodologies typical of BIM design will be introduced and the use of basic construction elements will be taught that will allow the student to create structures and surfaces typical of civil engineering and architecture. It will be taught to add topographic surfaces, modeling with masses and parametric elements, to later document the Project, which will allow the student to create projects. The course includes practical exercises aimed at consolidating student's use of this software. - Presentation of the BIM Revit software - Project in revir: organization, visualization, links, import-export of files and location and location. - Creation and edition of constructive elements. - Project Documentation: Surfaces, tables, details, Annotation, labels, legends, preparation of plans and boxes. - Topography and platforms. - Modeling of masses: conceptual and "in situ" - Creation and edition of families - Creation of advanced masses and components in situ: Curtain wall, surface pattern, adaptive component, spatial and adaptive structures. ------------------------------ Starting from the basic concepts and the handling of the BIM software, we will see its project application to surfaces geometric characteristics of Descriptive Geometry used by engineering and architecture:
S2-3. CAD_BIM
S3-3. CAD_BIM
S4-3. CAD_BIM
S5-3. CAD_BIM
S6-3. CAD_BIM
S7-3. CAD_BIM
S8-3. CAD_BIM
S9-3. CAD_BIM
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11. Application of BIM to the study of geometric surfaces typical of Descriptive Geometry through the generation of masses and adaptive components. 11.1. Developable surfaces: 11.1.1. Geodesic - Icosahedral - Dodecahedral domes 1.2. Folds - Linear - On curved surfaces - Bidirectional - Discontinuous - Radial - Combinations and groupings - Vault and Domes 11.1.3. Flat double-layer spatial lattice structures - Triangular, square and hexagonal equipartitions. 11.2. Simple curvature surfaces: 11.2.1. General concepts 11.2.2. Cylindrical surfaces and sections 11.2.3. Conical surfaces and sections 11.2.4. Intersections between surfaces of simple curvature - Conical lunettes - Cylindrical lunettes - Vaults by edge and cloister corner - Intersections between conical and cylindrical surfaces. 11.3. Elliptical Quadrics and their applications 11.3.1. General concepts - elliptical quadrics and scales 11.3.2. Vaulted Domes and Vaults with straight and inclined planes - Triangular base - Square base - Pentagonal Base - Hexagonal Base 11.3.3. Elliptical domes of revolution and spherical caps. 11.5. Ruled ruled surfaces - Concept and classification 11.5.1. Triaxial ruled surfaces - Concept - Ruled and revolution hyperboloid - Hyperbolic paraboloid - Combinations - Traction surface using paraboloids - Vaults by parabolic edge 11.5.2. Biaxial ruled surfaces - Concept and types - Straight and oblique circular cone - straight elliptical conoid - Double straight cone - Combination of conoids 11.5.3. Axial ruled surfaces - Concept - General cylinder and master plane - Ordinary and oblique pitch cap - Straight cylindrical helical 11.5.4. Anaxial ruled surfaces - oblique cylindrical helical.

Specific objectives:
- Preparation of students for the use of computer instruments using BIM software as a projecting tool and for solving geometric problems. - Identify and represent through the system of multiple, dihedral, axonometric and conical views, the characteristics of bodies, surfaces and objects, according to their location in space. - Know, identify, represent and use the known surfaces and volumes in descriptive geometry using BIM software applied to projects. - Application of current computer tools (BIM software) to graphic representation in the field of Civil Engineering through the use of parametric-type assisted design programs. - Introduction of the student in the rational use of computer science as a work base, under the "interface" of the operating systems, and the application of the specific BIM software as a 2D and 3D project drawing tool. Always under the conceptual guideline of the geometric structuring of the projects to be represented and the help of informatics in the field of descriptive geometry and technical drawing.

Full-or-part-time: 28h 47m
Theory classes: 2h
Practical classes: 10h
Self study : 16h 47m

EV: Evaluation

Full-or-part-time: 14h 23m
Laboratory classes: 6h
Self study : 8h 23m

GRADING SYSTEM

The final score is the sum of partial scores following:

NPRp: qualification Personal internships (12 personal internships)
NPRec: qualification Continuous assessment practices (5 classroom practices)
NPRbim: qualification BIM practices (classroom practices)
NEec1: continuous assessment rating 1 review
NEec2: continuous assessment test grade 2

The final practice mark is obtained from the following operation:

NPR = 0.1 * NPRp + 0.10 * NPRbim + 0.1 * NPRec

The final mark for continuous assessment tests will be:
NE = 0.30 * NPEC1 + 0.40 * NPEC2

The FINAL YEAR COURSE MARK is obtained from the following operation:

NFcurso = NPR + NE + 0.1 * NF
(10% of the NF will be added to the final grade of the course if the student has a mark through the evaluation >= 6.0, and has also carried out an adequate follow-up of the subject, taking as a reference an attendance > 85% of the classes).

PRACTICES:

Students will have a collection of 17 exercises in Diedric system divided into two groups: personal practices (12) and classroom practices (5). In this collection, students must submit all of the practices conveniently resolved. Deliveries will be made on a date to be determined by the teacher.

The average of the 12 personal practices, the 5 classroom practices and the BIM practices will result in the qualification of the personal practices (NPp), the qualification of the continuous evaluation practices (NPec) and the qualification of the BIM practices (NPbim) respectively.

It is important to be punctual in the delivery of the internships:
- A delay of between 24h and one week will be penalised by 20%.
- A delay of between one week and two weeks will be penalised by 40%.
- A delay of more than two weeks will not be accepted.

The score of the practices will have a weight of 30% in the final grade of the subject, so it is recommended its completion and maximum care, as well as attendance to class.

CONTINUOUS ASSESSMENT

Continuous assessment is to make different individual activities, additive and formative in nature, made during the course (classroom).

Continuous assessment is divided in two parts: the practice of continuous assessment and continuous assessment tests.

During the course, and in the days stipulated for such programming on the subject, there will be 5 continuous assessment practices, half of which will result NPec rating. Their weight in the final of the course is 10%.

There will be two exams, whose contents correspond to the subject taught in class until the date of each one of them. The total weight of these in the final grade is 70%.

Final Exam (for students who have not obtained the approval of course), all matters shall be provided along the course.

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

EXAMINATION RULES.

If any of the continuous assessment activities are not carried out in the scheduled period, it will be considered as a zero score.

BIBLIOGRAPHY

Basic:
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- Costa Buján, P. Geometrías básicas y formas arquitectónicas : presentaciones y modelos. 1a ed. Santiago de Compostela: Andavira Editora, 2018. ISBN 8484089215.
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- Rendón Gómez, Á. Geometría paso a paso: vol. III: sistema diédrico. Madrid: Tébar, 2001.
- Taibo, A. Geometría descriptiva y sus aplicaciones. 2a ed. Madrid: Tébar, 2010. ISBN 9788473603478.