UNIVERSIDAD DE BURGOS

COURSE DESCRIPTIONS

Joint Degree in Civil Engineering and Technical Architecture

➢ First year:

7923 Calculus

TOPIC 1. REAL FUNCTIONS OF REAL VARIABLE

Real numbers. Complex numbers. Limit of a function at a point and properties. Algebraic limits and operations. Calculation of limits. Infinity and infinite. Continuity and properties. Types of discontinuities. Theorems on continuity.

TOPIC 2. DERIVATION AND APPLICATIONS

Concept and geometric interpretation. Derivatives and algebraic operations. Chain rule. Derivatives of some functions. Growth of a function at a point, relative ends and concavity. Theorems of derivable functions. Taylor's formula. Study and tracing of flat curves. Hyperbolic functions.

TOPIC 3. CALCULATION OF PRIMITIVES

Primitive of a function. Indefinite integral. General integration procedures.

TOPIC 4. DEFINITE INTEGRAL AND APPLICATIONS

Definition and properties. Mean Value Theorem. Fundamental Theorem of Calculus. Barrow's rule. Change of variable. Integration by parts. Basic notions of improper integrals. Applications of the definite integral to the calculation of areas, lengths and volumes.

TOPIC 5. NUMERICAL SERIES AND SERIES OF POWERS

Convergent, divergent and oscillating series. Geometric series. Convergence criteria for series of positive terms. Alternate series: Leibniz criterion. Any series of terms: absolute convergence. Power series: radius and convergence field. Development of a function by series of powers.

PART II. NUMERICAL CALCULUS

TOPIC 6. NUMERICAL RESOLUTION OF EQUATIONS

Introduction. Bisection method. Iteration of fixed point. Newton's method. Secant method.

TOPIC 7. POLYNOMIAL INTERPOLATION

Introduction. Lagrange polynomial. Lagrange form. Newton's form: divided differences. Dimensioning the error. Segmental polynomial interpolation. Hermite interpolation.

TOPIC 8. INTEGRATION OR NUMERICAL QUADRATURE

The problem of the numerical square. Quadrature rules. Quadrature error. Complex integration. Complex integration rules. Error in compound rules.

7924 Physics

TOPIC 1. DIMENSIONAL ANALYSIS

- Elements of dimensional analysis.

TOPIC 2. PARTICLE MECHANICS

- Kinematics of the particle.
- Dynamics of the particle.
- Work and power.
- Kinematics and dynamics of particle systems.

TOPIC 3. OSCILLATORY AND WAVE MECHANICS

- Oscillatory motion.

- Wave motion.

TOPIC 4. FLUID MECHANICS

- Fluid statics.
- Fluid dynamics.

7925 Applied Geology

UNIT 1: BASIC GEOLOGY

TOPIC 1: GEOLOGIC TIME

1. Geologic time and processes in the history of the earth.
2. Geochronology: methods of dating rocks.
3. Divisions of geologic time.

TOPIC 2: STRUCTURE AND COMPOSITION OF THE EARTH

1. Physical characteristics of the earth.
2. Methods of research of the interior of the earth.
3. Structure and composition of the crust.
4. Cortical plates.

TOPIC 3: PLATE TECTONICS

1. Arguments in favor of continental drift.
2. Paleomagnetism: the final proof.
3. The concept of plate and plate tectonics.
4. Orogenies.

TOPIC 4: STRUCTURAL GEOLOGY

1. Mechanical behavior of rocks.
1.1 Theoretical behaviors and mechanical analogies.
1.2 Rock behavior in the laboratory.
1.3 Factors that influence the behavior of rocks.
2. Fragile behavior.
2.1 Coulomb-griffith failure criteria.
2.2 Mohr envelope. Influence of fluid pressure.
2.3 Creation and movement of faults.
2.4 Faults.
2.5 Joints.
3. Ductile behavior.
3.1 Fold mechanisms.
3.2 Folds.
3.3 Diapirs.

TOPIC 5: STRATIGRAPHY

1. Concept of stratigraphy.
2. Fundamental principles.
3. Objectives of stratigraphy.
4. Concept of stratum.
5. Stratification.
6. Facies.
7. Lithostratigraphic units.
8. Polarity criteria.
9. Stratigraphic sections.
10. Events in the stratigraphic record.

TOPIC 6: MINERALOGY AND PETROLOGY

1. Concept of mineral.
2. Notions of crystallography.
3. Mineral classification.
4. Concept of rock.
5. Rock classification.
6. Petrographic cycle.

UNIT II: APPLIED GEOLOGY

TOPIC 7: IGNEOUS ROCKS - Classes, uses and problems

1. Concept.
2. Mineralogical composition of igneous rocks.
3. Igneous rock textures.
4. Igneous rock classes.
5. Main igneous rocks. Uses and problems in civil engineering.
* observation of igneous rocks to prepare the test exam 2 "Identification of Minerals and Rocks".

TOPIC 8: SEDIMENTARY ROCKS - Classes, uses and problems

1. Concept.
2. Mineralogical composition of sedimentary rocks.
3. Sedimentary rock texture.
4. Sedimentary rock classes.
5. Main sedimentary rocks. Uses and problems in civil engineering.
* observation of igneous rocks to prepare the test exam 2 "Identification of Minerals and Rocks".

TOPIC 9: METAMORPHIC ROCKS. Classes, uses and problems

1. Concept of metamorphism.
2 main metamorphic minerals.
3 types of metamorphism.
4 main metamorphic rocks. Uses and problems in civil engineering.
* observation of metamorphic rocks to prepare the test exam 2 "identification of minerals and rocks".

TOPIC 10: ROCK MASS

1. Weathering: mechanical, chemical, biological.
2. Discontinuities of the rock matrix: stratification, joints, faults.
3. Instabilities in the rock mass.
4. Rock mass characterization. Methodology.
5. Main geomechanical classifications.

TOPIC 11: METHODS OF GEOLOGICAL EXPLORATION

1. Indirect methods.
1.1 Photogeology and remote sensing.
1.2 Geophysical prospection: seismic, electrical, geo-radar, gravimetry.
2. Direct methods.
2.1 Geological surveys.

2.2 Exploration.
2.3 Wells.
2.4 Boreholes.

TOPIC 12: GEOMORPHOLOGY AND CLIMATOLOGY

1. Soil morphology. Climatology.
2. Analysis of drainage basins.
3. The erosion.
4. Transportation and sedimentation.
5. Rivers.
6. Civil work and geomorphology.
7. Geomorphological maps.

TOPIC 13: HYDROGEOLOGY

1. Concept of hydrogeology.
2. The presence of water in the subsoil.
3. Hydrogeological parameters.
3.1 Porosity.
3.2 Permeability.
3.3 Transmissivity.
3.4 Storage coefficient.
4. Aquifers.
4.1 Definition of aquifer.
4.2 Types of aquifers.
4.3 Water table level and piezometric level.
4.4 Geological formations such as aquifers.
4.5 Other: aquiclude, aquitard, aquifuge.

TOPIC 14: WATER IN ROCK MASS

1. Ground water.
2. Influence of ground water and works.
3. Treatment of rock mass waters.

TOPIC 15: GEOLOGY IN CIVIL WORKS

1. Dams.
2. Tunnels.
3. Open pit excavations.
4. Roads and railways.
5. Port works.
6. Channels and conduits.
7. Buildings.

UNIT III: APPLIED GEOLOGY PRACTICES

LABORATORY PRACTICES

- Practice 1: Calculation of directions and dips of planes. The three-pint problem. Apparent dips.
- Practice 2: Calculation of Powers and Cartographic Map of Strata.
- Practice 3: Fault problems. Calculation of Fault Jumps.
- Practice 4: Geological cross-section (4-1st part: Simple Cuts, 4-2nd part: Complex cuts)
- Practice 5: Geological History and Stratigraphic Sections

IDENTIFICATION OF MINERALS AND ROCKS: It will take place in the THEORY CLASSROOM, together with topics 6, 7, 8 and 9. Samples related to the preparation of TEST 2 will be displayed

7926 Computing in Civil Engineering

UNIT A: INTRODUCTION TO COMPUTER SCIENCE

1 Basic concepts. Information coding, computer architecture.
2 Introduction to Operating Systems.
3 Introduction to computer networks and the Internet.
4 Introduction to Programming.
5 History of Information Technology.

UNIT B: USE OF BASIC TOOLS

6 Spreadsheets.
7 Word processing.
8 Generation of Presentations

7927 Building physics and technology

INTRODUCTION TO CONSTRUCTION

CONSTRUCTION OF A BUILDING

1.1. Introduction. Knowledge of construction. Its impact on the project.
1.2. Elements, function, types according to use.
1.3. Man as a unit of measurement. Proportions.
1.4. Dimensions of spaces and their interconnection.
1.5. The door.
1.6. The staircase.
1.7. Building safety.
1.8. Regulations for the construction of a building.

APPROPRIATE STRUCTURAL SUPPORT. INTRODUCTION TO STRUCTURES

2.1. Purpose and requirements.
2.2. Actions and efforts.
2.3. Construction systems. Operations.
2.4. Materials for the construction of structures.
2.5. Types of buildings. Tall buildings.
2.6. Roofing structures.

THE ENCLOSURES

3.1. Thermal insulation.
3.2. Acoustic insulation.
3.3. Clean air. Ventilation.
3.4. The window. Glazing.
3.5. Usual types of enclosures.

WATER IN A BUILDING

4.1. Clean water.
4.2. The evacuation of water.
4.3 Humidity.

ENERGY NEEDS IN A BUILDING.

5.1. Energy diversity.
5.2. Electricity.
5.3. Other types of energy.

WASTE IN A BUILDING

6.1. Evacuation of liquid waste.
6.2. Evacuation of solid waste.
6.3. Waste recycling.

QUALITY

7.1. Quality.
7.2. Quality in construction.
7.3. Quality control.

THE PROJECT

8.1. The Preliminary Project.
8.2. The basic project. Documents.

8.3. The execution project. Documents.
8.4. Project control.
8.5. The project according to the CTE.

THE TERRAIN AND FOUNDATIONS

INTRODUCTION AND GENERAL CONCEPTS

1.1. General concepts. Program. Bibliography and regulations.
1.2. General construction concepts.
1.3. Construction elements.

THE TERRAIN

2.1. Lands. Properties. Execution incidence.
2.2. Lands. Classification and regulations.
2.3. Lands. Geotechnical surveys.
2.4. Earth movements. Definition and general information. Execution and safety conditions.
2.5. Earth movements. Excavations. Ditches and wells.
2.6. Earth movements. Fillers. Compacting. Slopes.

THE FOUNDATION

3.1. Structural elements and historical evolution.
3.2. Foundation. Actions and loads. Types.
3.3. Foundation. Shallow foundations.
3.3.1. Footings. Types and execution.
3.3.2. Slab. Types and execution.
3.4. Foundation. Deep Foundations.
3.4.1. Wells. Types and execution.
3.4.2. Piles. Types and execution.
3.5. Foundation. Consolidation systems.

CONTAINMENT SYSTEMS

4.1. Containment systems Types.
4.2. Containment systems. Executed after excavation.
4.2.1. Retaining walls.
4.2.2. Reinforced earth.
4.3 Containment systems. Executed prior to excavation.
4.3.1. Screen walls.
4.3.2. Pile walls.
4.4. Containment systems. Executed with the excavation.
4.4.1. Sheet pilings.
4.4.2. Shorings.
4.5. Containment systems. Drainage. Drainage.

PROJECTS AND AUXILIARY ELEMENTS

5.1. Reframing Alignments and flushings. Execution.
5.2. Auxiliary constructions. Scaffolding.
5.3. Auxiliary constructions. Formwork Types. Execution.

WORKSHOP PRACTICES

1 Land reconnaissance. Properties.
2 Execution of shallow foundation.
3 Execution of containment systems. Screen wall. Pile wall.
4 Shorings. Sizing.
5 Reframing of shallow foundation. Aligning boundaries.

7928 Descriptive Geometry with 3D CAD

PART I. CONCEPT BIDIMENSIONAL SYSTEM

UNIT 1. MANIPULATION OF THE TWO-DIMENSIONAL FORMAT

- Digital graphical tools
- Introduction to CAD

UNIT 2. TWO-DIMENSIONAL OBJECTS

- Point objects
- Linear objects
- Surface objects
- Parametric objects

UNIT 3. PROPERTIES OF BIDIMENSIOAL OBJECTS

- General Properties
- Geometric Properties
- Parametric Properties

PART II. THREE-DIMENSIONAL SYSTEM CONCEPT

UNIT 4. THE MANIPULATION OF THREE-DIMENSIONAL SPACE

- Digital graphical tools
- Introduction to Sketchup

UNIT 5. THREE-DIMENSIONAL OBJECTS

- Point objects
- Linear objects
- Surface objects
- Polyhedral objects
- Solid objects

UNIT 6. GEOMETRIC CONSTRUCTION OF THREE-DIMENSIONAL OBJECTS

- Extrusion

- Sweep
- Union
- Subtraction
- Revolution
- Mesh

UNIT 7. PROPERTIES OF THREE-DIMENSIONAL OBJECTS

- General Properties
- Geometric Properties
- Parametric Properties

PART III. INTRODUCTION TO MODELING

UNIT 8. MODELING AND REPRESENTATION OF ELEMENTARY GEOMETRIES

- Orthogonal cylindrical projection.
- Diedral applications.
- Parallel perspectives.
- Shadows as a rendering tool

UNIT 9. MODELING AND REPRESENTATION OF COMPLEX GEOMETRIES

- Conical cylindrical projection.
- Perspectives applications.
- The movements as a tool of Representation

7929 Applied mechanics

BLOCK I. SYSTEMS OF FORCES

TOPIC 1: SYSTEMS OF FORCES

Introduction.

1.1.- Moment of a force with respect to a point.
1.2. - Moment of a force with respect to an axis.
1.3. - Characteristics of force systems.
1.3.1. - Resultant and resultant moment.
1.3.2. - System Invariants.
1.3.3. - Minimum moment and central axis.
1.4. - Types of force systems.
1.4.1. - Torque forces.
1.4.2. - Concurrent forces. Avignon's theorem
1.4.3. - Parallel forces.
1.4.4. - Coplanar forces.
1.5. - Equivalent force systems.
1.6. - Reduction of force systems.

BLOCK II: MASS GEOMETRY

TOPIC 2. CENTRES OF GRAVITY

Introduction.

2.1. - Centre of gravity of bodies.
2.2. - Static momentum of surfaces.
2.3. - Guldin-Pappus Theorem.
2.4.- Application: Distributed loads

TOPIC 3. MOMENTUM OF INERTIA

Introduction.

3.1. - Moments of surface inertia.
3.2. - Product of surface inertia.
3.3. - Steiner's theorem. Axis transposition.
3.4. - Moment of Inertia with respect to rotated axes. Main axes of inertia.
3.4.1. - Momentum of Inertia with respect to a rotated axis.
3.4.2. - Main axes of inertia.

BLOCK III. APPLIED STATICS

TOPIC 4. STATICS OF A RIGID SOLID BODY

Introduction.

4.1. - Rigid Body Concept.
4.2. - Degrees of freedom. Diminished degrees of freedom.
4.3. - Ligatures. Mechanical effects.
4.4. - Equilibrium of rigid bodies.

TOPIC 5. RIGID SYSTEM STATIC.

Introduction.

5.1. - Equilibrium of various solids.
5.2. - Articulated structures. Spatial and flat.
5.3. - Flat articulated structures.
5.3.1. - External, internal and overall equilibrium.

5.3.2. - Analytical methods of resolution.

TOPIC 6. FRICTION
Introduction.
6.1. - Mutual actions of contact between solids.
6.2. - Sliding friction.

BLOCK IV: INTERNAL FORCES IN RIGID SOLIDS IN EQUILIBRIUM

TOPIC 7. INTERNAL FORCES IN SOLIDS

Introduction.

7.1. - Internal forces in a solid in equilibrium.
7.2. - Transversal section stress.

7.3. - Internal forces in a flat beam.
7.3.1. - Convention on signs.
7.3.2. - Equilibrium of a slice.
7.3.3. - Stress/strain diagrams.
7.4. - Study of beams.

TOPIC 8. FUNDAMENTALS OF ELASTICITY

Introduction.

8.1. - Elastic bodies. Hooke's Law.
8.2. - Longitudinal stresses.
8.2.1. - Traction and compression.
8.2.2. - Pure bending.
8.2.3. - Complex Bending.

BLOCK V: KINEMATICS AND DYNAMICS OF RIGID SOLIDS

TOPIC 9. KINEMATICS OF RIGID SOLIDS

Introduction.

9.1. - Kinematic rigidity condition.
9.2. - Translation and rotation motions.
9.3. - Velocity field of rigid solids.
9.4. - General motion of rigid solids.
9.5. - The field of accelerations of rigid solids**.**

TOPIC 10. DYNAMICS OF RIGID SOLIDS

Introduction.

10.1. - Angular moment of a solid in rotation.
10.2. - Fundamental equation of rotation dynamics around a fixed axis.
10.3. - Energetic aspects of the motion of a rigid solid.
10.4. - Rolling motion.

7930 Material oriented chemistry

1. INTRODUCTION TO CHEMICAL SCIENCE

1.1 Basic concepts of Chemistry.
1.2 Stoichiometric calculations.
1.3 Study of chemical reactions.

2. SOLID STATE AND EQUILIBRIA BETWEEN PHASES

2.1 Types of solids and properties.

2.2 Solid-liquid phase diagrams.

3. NATURE, BEHAVIOUR AND DEGRADATION OF INORGANIC MATERIALS

3.1 Metallic materials: electrochemical corrosion, factors and methods of protection.

3.2 Other materials.

4. NATURE, BEHAVIOUR AND DEGRADATION OF ORGANIC MATERIALS

4.1 Introduction to Organic Chemistry.

4.2 Structure, properties and applications of polymeric materials.

7931 Materials oriented physics

ELECTRICAL AND MAGNETIC PROPERTIES OF MATTER

Electrostatics: field, potential and electrostatic properties of materials. 1.1 Electrical load. Coulomb's Law Electrostatic field. Electrostatic potential. 2.2 Electrostatic potential energy. Capacity and Capacitors. Permittivity.

DIRECT CURRENT

Electric current. Electric resistance and Ohm's law. Energy in electrical circuits. Laws of the circuits: association of resistance and Kirchhoff's Laws.

MAGNETISM: FIELD AND MAGNETIC PROPERTIES OF MATERIALS.

Magnetic field. Effects of magnetic field. Sources of magnetic field. Classification of materials by their magnetism. Permeability.

ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

Faraday's and Lenz's Law. Self-induction Generators and engines. Series RLC circuit. Ohm's

Power of an AC circuit. Transformers

THERMAL PROPERTIES OF MATTER HEAT AND TEMPERATURE

Heat and temperature

Temperature, Zeroth law of thermodynamics. Properties and thermometric scales: thermometers. Dilatation. Heat: conduction, convection, radiation. Calorimetry, heat capacity and specific heat. Phase changes. Thermodynamic equilibrium. Thermodynamic processes. Ideal gas.

FIRST AND SECOND PRINCIPLES OF THE THERMODYNAMICS

Heat, work and internal energy. First law. Heat and ideal gas work in simple processes.
Second law: thermal machines.

7932 Applied mathematics II

PART I. BASIC NOTIONS

1.-SYSTEMS, MATRICES AND DETERMINANTS

Linear systems.
Matrices.
Determinants.
Rank of a matrix.

PART II. VECTOR SPACES.

2.-VECTOR SPACES

Real vector space.
Subspaces.
Bases and dimension.
Space of the rows of a matrix.
Coordinates and base changes.

3.-EUCLIDEAN VECTORAL SPACE

Inner product.
Standard and distance.
Angles and orthogonality.
Orthonormal base changes.
Orthogonal matrices.

PART III. LINEAR APPLICATIONS.

4.-LINEAR APPLICATIONS

Concept of linear application and properties.
Image and nucleus of a linear map.
Matrix and equations of a linear map.
Similarity of matrices.

5.-DIAGONALIZATION

Eigenvalues and Eigenvectors.
Characteristic polynomial, characteristic subspace.
Diagonalization.
Orthogonal diagonalization.

PART IV. GEOMETRIC PLACES IN THE PLANE AND IN SPACE.

6.-GEOMETRIC LOCI ON THE PLANE AND IN SPACE

GEOMETRIC LOCI ON THE PLANE

Reduction and classification of conics.
Quadrants.

7933 Materials I

THEMATIC UNIT 1. CERAMIC PRODUCTS

TOPIC 1. GENERAL INFORMATION AND MANUFACTURE OF CERAMIC PRODUCTS
TOPIC 2. FIRED CLAY CERAMIC PIECES FOR BRICKWORK MASONRY.
TOPIC 3. CERAMIC VAULTS FOR FRAMING.
TOPIC 4. CERAMIC TILES.
TOPIC 5. DOMESTIC SANITARY CERAMICS.
TOPIC 6. CERAMIC PAVERS.

THEMATIC UNIT 2. GLASSES

TOPIC 1. GENERAL INFORMATION ON GLASSES.
TOPIC 2. GLASS MANUFACTURING AND FINISHING PROCESSES.
TOPIC 3. COMMERCIAL GLASS.

THEMATIC UNIT 3. PLASTERS

TOPIC 1. GENERAL INFORMATION ON PLASTERS AND THEIR MANUFACTURE.
TOPIC 2. CHARACTERISTICS AND PROPERTIES OF PLASTERS.
TOPIC 3. TYPES OF COMMERCIAL PLASTERS AND PREFABRICATED PLASTER PRODUCTS.

THEMATIC UNIT 4. AERATED LIME AND HYDRAULIC LIME

TOPIC 1. GENERAL INFORMATION ON AERATED LIME AND HYDRAULIC LIME AND THEIR MANUFACTURE.
TOPIC 2. CHARACTERISTICS AND PROPERTIES OF AERATED LIME AND HYDRAULIC LIME.

TOPIC 3. TYPES OF COMMERCIAL LIME.

THEMATIC UNIT 5. CEMENTS

TOPIC 1. GENERAL INFORMATION, MANUFACTURE AND PROPERTIES OF CEMENTS.
TOPIC 2. COMPOSITION OF CEMENTS.
TOPIC 3. TYPES OF CEMENTS ACCORDING TO RC-16.
TOPIC 4. TYPES OF CEMENTS ACCORDING TO RD 1313.
TOPIC 5. OVER-SULFATED CEMENTS.

THEMATIC UNIT 6. MASONRY MORTARS AND ADHESIVES

TOPIC 1. GENERAL INFORMATION ON MORTARS AND RAW MATERIALS OF MORTARS.
TOPIC 2. DOSING, KNEADING AND PROPERTIES OF MORTARS.
TOPIC 3. ADHESIVES: CONCEPT AND PROPERTIES.

PLASTER PROBLEMS.

CEMENT PROBLEMS.

PARTICLE SIZE PROBLEMS.

MORTAR DOSING PROBLEMS.

LABORATORY PRACTICES.

OTHER MATERIAL ACTIVITIES I.

Study of the EC marking of construction products.

Study of the reception of materials on-site according to CTE.

Conferences programmed by the subject teaching team.

7934 Construction II

TOPIC 1. MASONRY AND ITS MATERIALS

1.1. Fundamental concepts.
1.2. Scope.
1.3. Materials used.
1.3.1. Groups of parts.
1.3.2. Terminology.

1.3.3. Characteristics of bricks.

1.3.4. Mortars.
1.3.5. Pastes.
1.3.6. Concrete.

TOPIC 2. BRICKWORK AND WALLS

2.1. Scope of application of CTE DB SE-F.
2.2. General information.
2.3. Types of walls by their constructive organization.
2.3.1. Single-wither walls.
2.3.2. Stretcher bond walls (offset joint pattern).
2.3.3. Double-wither walls.
2.3.4. Mixed masonry wall.
2.3.5. Cavity walls.
2.3.6. Cladding walls.
2.3.7. Reinforced walls.
2.4. Structural criteria.
2.4.1. Compressive strength.
2.5. Links between walls and framing.
2.5.1. General information.
2.5.2. Link by connectors.
2.5.3. Link by friction.
2.6. Movement joints.
2.6.1. Installation of movement joints.

TOPIC 3. PRE-FABRICATED BRICK WALLS

3.1. General information.
3.2. Types of courses.
3.3. Type of joints.
3.4. Brick laying.
3.5. Bonding rules for high-strength masonry walls.
3.6. Bonds.
3.7. Types of bonds.
3.7.1. Stretcher bonds.
3.7.2. Heading bond.
3.7.3. English bond.
3.7.4. Belgian bond.
3.7.5. Dutch bond.
3.7.6. Flemish bond.
3.8. Practical rules for the insertion of ties in bonded walls.
3.9. Solution of wall junctions.
3.9.1. Stretcher bonds.
3.9.2. Heading bond.
3.9.3. English bond.
3.9.4. Belgian bond.
3.9.5. Dutch bond.
3.9.6. Flemish bond.
3.10. Columns.
3.10.1. Square columns.
3.10.2. Rectangular columns.
3.10.3. Columns in the form of a cross or cruciform.
3.10.4. Corner columns.
3.11. Layout of walls made of brick masonry

TOPIC 4. CONDITIONS AND SUPERVISION OF MASONRY WALL CONSTRUCTIONS

4.1. Construction of walls.
4.1.1. Levelling the ground for the wall foundation.
4.1.2. Laying out the wall.
4.1.3. Humidification.
4.1.4. Placement of parts.
4.1.5. Filling of joints.
4.1.6. Raising the wall.
4.1.7. Masonry bonds.
4.1.8. Channels and protrusions.
4.1.9. Layout of reinforcement mesh.
4.2. Supervision of construction.
4.2.1. Reception of materials.
4.3 Brickwork Control.
4.3.1. Categories of implementation.
4.4. Working tolerances.
4.5. Mortars and filler concretes.
4.6. Reinforcement meshes.
4.7. Protection of masonry under construction.

TOPIC 5. CONCRETE BLOCK WALLS

5.1. Definition.
5.2. Classification of blocks.
5.3. Types of parts.
5.4. Masonry bonds for concrete blocks.
5.5. Conditions for construction.
5.6. Construction details.

TOPIC 6. WALLS OF LIGHTENED CERAMIC BLOCK

6.1. Definition.
6.2. Technical characteristics.
6.3. Part types.
6.4. Masonry bond for ceramic block.
6.5. Conditions for construction.
6.6. Construction details.

TOPIC 7. MASONRY REINFORCED BY MORTAR COATING

7.1. Introduction.
7.2. Meshes.
7.2.1. Control and reception of meshes.

7.3. Incorporation of mortar coating on meshwork.
7.3.1. Placement of the mesh.
7.3.2. Anchorage and overlap.
7.3.3. Bond between walls.
7.4. Fields of application.

TOPIC 8. BRICKWORK LINTELS AND ARCHES

8.1. Definition.
8.2. Nomenclature.
8.3. Classification by constructive organization.
8.3.1. Bonded.
8.3.2. Arch ring.
8.3.3. Lintel arches
8.4. Threshold arches.
8.4.1. Types.
8.4.2. Execution process.
8.4.3. False lintel arch.
8.5. Semi-circular arch. Construction process.
8.6. Overhanging eaves.
8.7. Rupture of arches.
8.8. Laying out arches and brick lintels.

TOPIC 9. BONDING AND CONSTRUCTION OF BRICK VAULTS

9.1. Definition.
9.2. Nomenclature.
9.3. Classification by constructive organization.
9.3.1. Bonding.
9.3.2. Ring arches.
9.3.3. Ribbed.
9.3.4. Brickwork vaults.
9.4. Execution of brickwork vaults.
9.5. Brickwork stairs.

TOPIC 10. INTERIOR PARTITION WALLS AND PARTITIONS

10.1. Definition.
10.2. Ceramic brick partition walls.
10.3. Plate and panel partition walls.
10.4. Panelled Partition walls or with framework.
10.5. Reinforced partition walls.
10.6. Glass or translucent partition walls.
10.7. Execution systems.
10.8. Coatings and finishes in partition walls.

TOPIC 11. ROOFS

11.1. Definitions and Nomenclature.
11.2. Elements that make it up.
11.3. Execution systems.
11.4. Masonry finishes.
11.5. Lay out and outline of roofs.

TOPIC 12. WORKSHOP PRACTICES

1. Part types according to CTE (Coding Ticino de Edificación) [Technical Building Code].
2. Type of walls according to CTE.
3. Brickwork reinforced by mortar coating.
4. Links Me.
5. Links II.
6. Conditions for the construction of walls and arches.
7. Breeze block walls.
8. Roofs.
9. Pre-frames.
10. Partition walls and cladding.

HISTORY OF CONSTRUCTION

INTRODUCTION. ARCHITECTURE AND CONSTRUCTION, GENERAL CONCEPTS,

BUILDING TYPOLOGIES.

CONSTRUCTION SYSTEMS. GENERAL CONCEPTS.

CLASSIFICATION.

2.1. Lintel system.
2.2. Vaulted system.

EXTRAORDINARY SUPPORTS. CONCEPTS, TYPOLOGIES, CLASSIFICATION.

3.1. Pillars, columns and pilasters.
3.2. Stylistic, typological and constructive characteristics.

CONTINUOUS SUPPORTS. CONCEPTS, TYPOLOGIES, CLASSIFICATION.

4.1. According to the type of material.
4.2. According to its composition.
4.3 Construction typologies, historical evolution.

CEILINGS. CONCEPTS, TYPOLOGIES, CLASSIFICATION.

5.1. Lintel system.

5.2. Vaulted system.

ROOFS. GENERAL CONCEPTS, TYPOLOGIES, EVOLUTION.

6.1. Structural elements, concepts, typologies, structural forms, classification and evolution.
6.2. Coverage elements, concept, typologies and evolution.

MORTARS, COATINGS, FLOORS. CONCEPTS, TYPES, EVOLUTION
HISTORICAL RELATIONSHIP OF THE DIFFERENT ARCHITECTURAL STYLES.

7935 Architectural drawing I

UNIT 1. SKETCHING

- Freehand drawing.
- Architectural sketches. Development process. Dimensioning.

UNIT 2. DRAWING UP OF PLANS

- Scales. Concept and application.
- Architectural survey. Planimetric interpretation and representation.

UNIT 3. APPLICATION OF REPRESENTATION SYSTEMS

- Application of the Dihedral system in the architectural interpretation and representation.
- Application of perspective systems in visualization and representation.

UNIT 4. GRAPHIC TECHNIQUES

- General information on standardization, symbology and representative conventionalisms.
- Importance in architectural plans.
- Manual procedures and application of digital tools: AutoCAD, Sketchup and
- Revit at beginner level.

7936 Statistics

BLOCK I. DESCRIPTIVE STATISTICS AND PROBABILITY

ONE-DIMENSIONAL AND TWO-DIMENSIONAL DATA ANALYSIS

1.-Introduction: Sample. Statistical variable. 2. - Presentation and representation of data.

3. - Characteristic measures: parameters of position, dispersion, and asymmetry.

4. - Two-dimensional data analysis. Linear regression.

Probability and Combinatorics

1. Introduction. 2. Event space. 3. Axiomatic definition of probability.

4. Conditional probability. 5. Bayes theorem. 6. Appendix: Combinatorial.

BLOCK II. PROBABILITY DISTRIBUTIONS

RANDOM VARIABLES: MEASUREMENTS OF POSITION, DISPERSION, ASYMMETRY AND KURTOSIS

1. Introduction.
2. Random variable.
3. Probability distributions in random discrete variables.
4. Probability distributions in random continuous variables.
5. Characteristic measures. 6.- Independence of variables.

Discrete Probability Distributions Continuous Probability Distributions

1. Introduction. Discrete distributions.
2. Uniform.
3. Bernoulli
4. Binomial.
5. Poisson.
6. Approximation of Binomial to Poisson.
7. Introduction. Continuous
8. Uniform.
9. Normal distribution.
10. Central limit theorem: Approximations to normal.

BLOCK III. SAMPLING DISTRIBUTIONS

DISTRIBUTIONS ASSOCIATED WITH NORMAL DISTRIBUTION

1. Distribution associated to the normal: Pearson, Student, Fisher-Snedecor.
2. Appendix: Other distributions

SAMPLE DISTRIBUTION OF A PROPORTION, AN AVERAGE AND SAMPLE VARIANCE

1. Introduction.
2. Random and Statistical Samples.

3. Specific estimation.
4. Distribution of the sample average.
5. Distribution of the sampling variance.
6. Specific statistical distributions.
7. Distribution of the difference of two
8. Distribution of the ratio of sampling variances.
9. Statistics in proportions.

BLOCK IV. ESTIMATION

SPECIFIC ESTIMATION. ESTIMATION BY CONFIDENCE INTERVALS

Confidence

1. Introduction.
2. Intervals for a population.
3. Intervals for two populations

BLOCK V. STATISTICAL HYPOTHESIS TESTING

PARAMETRIC CONTRASTS

1. Introduction.
2. Elements of a contrast.
3. Contrasts for a population.
4. Contrasts for two populations.
5. Confidence intervals and hypothesis contrasts.

➢ Second year:

7937 Theory of structures

PART I. EFFORT LAWS IN ISOSTATIC STRUCTURES

UNIT 1. INTRODUCTION AND GENERAL REVIEW

- Centres of gravity.
- Static Moment.
- Moments of Inertia.
- Steiner Theorem
- Other concepts

UNIT 2. ACTIONS AND EFFORTS

- General information.
- Concept of efforts.
- Forces acting in a prismatic piece.
- Axial, Cutter, Bending Moments and torsion.
- System of connections and movements.
- Isostatics and indeterminate statics.

UNIT 3. LAWS OF STRESS IN ISOSTATIC STRUCTURES.

- Support reactions and effort laws in brackets.
- Support Reactions and efforts isostatic beam stress laws.
- Gerber Beams. -

PART II. STRESS ANALYSIS IN FLAT SECTIONS

UNIT 4. ELASTICITY THEORY.

- Introduction The elastic solid.
- Concept of Tension.
- Tensile state in one-point environment: inner equilibrium equations and equilibrium equations on the boundary.
- Generalized Hooke's Law.

-Relationship between landslides and Compatibility Equations.

- General approach to the problem of the elastic body.

UNIT 5. INTRODUCTION TO THE STRENGTH OF MATERIALS.

- Definitions.
- Simplifying Hypotheses of Elasticity Theory. The Resistance of Materials.
- Concept of Safety Coefficient.
- Hypothesis of calculation.
- Hooke's law.
- Compatibility conditions.
- Rethinking the elastic body problem.

UNIT 6. STRESS STATE: AXIAL EFFORT.

- General definition: Traction and compression.
- Internal equilibrium Equation and compatibility in deformations.
- Modulus of elasticity.
- Distribution of tension due to axial exertion.

UNIT 7. STRESS STATE: PURE FLEXION.

- General definition. Bending moment.
- Single-component bending moment.
- Equations of equilibrium and compatibility in deformations.
- Distribution of voltages.
- Bending moment with two components. Unsymmetrical bending. Distribution of Tensions.
- Resisting moment.

UNIT 8. STRESS STATE: COMPLEX BENDING.

- General definition. Overlapping of effects.
- Stress distribution. Neutral fibre. Compound tensile stress or compression; compound flexion.
- Central core.

UNIT 9. STRESS STATE: SIMPLE BENDING.

- General definition.
- Relationship between bending Moment and shear force.
- Tangential stresses. Stress distribution.

UNIT 10. STRESS STATE: TORSION.

- The concept of the torsion moment.
- Stress distribution produced by a torsion moment.
- Analogy of the membrane.
- Torsion in thin sections: open profiles without branching, open branching profiles, closed profiles of one or more cells.

UNIT 11. GENERAL STATE OF VOLTAGES.

-Statement of the problem.

- Composition of tensions.

PART III. DEFORMATIONS IN ISOSTATIC STRUCTURES.

UNIT 12. DEFORMATION OF AN ELEMENTAL SLICE.

- General information: Superposition Principle.
- Generalization of Hooke's Law.
- Elementary deformation produced by axial forces.
- Elemental deformation produced by bending moment.
- Elemental deformation produced by cutting stress
- Elemental Deformation produced by thermal stress.

UNIT 12. MOHR'S THEOREMS.

- Deformation of the prismatic piece subjected to axial stress.
- Deformation of prismatic piece subjected to bending moment.
- First theorem of Mohr.
- Second theorem of Mohr.
- Deformation in brackets.
- Deformation in isostatic beams.
- Third theorem of Mohr.
- Theorem of the conjugated beam.

UNIT 13. ELASTIC EQUATION

- Deformation Equation. -

UNIT 14. DEFORMATION ENERGY.

- General concept of deformation energy.
- Deformation energy by axial effort.
- Deformation Energy per bending moment.
- Deformation Energy by shear stress.
- Castigliano's Theorem.

PART IV. STATICALLY INDETERMINATE STRUCTURES

UNIT 15. STATICALLY INDETERMINATE STRUCTURES.

- General concepts.
- General Method of resolution of statically indeterminate structures.

UNIT 16. CONTINUOUS BEAMS.

- General method of resolution.
- Theorem of the three moments.

PART V. INDIRECT ACTIONS: DECREASE IN SUPPORT AND THERMAL STRESS

UNIT 17. INDIRECT ACTIONS: REDUCTIONS IN SUPPORT.

- Indirect actions: Decrease in supports, supports and elastic embedding.

UNIT 18. INDIRECT ACTIONS: THERMAL STRESSES

- Thermal Efforts.
- Constant temperature variation along the edge.
- Linear temperature Variation along the edge.
- Deformation in cantilevers: Turns and slippage. –
- Deformation in bi-supported beam: Rotation at the ends.

7938 Hydraulics

UNIT 1. INTRODUCTION

INTRODUCTION, Fluid Properties

UNIT 2. FLUID STATICS

Pressure, Hydrostatic Pressure Distributions, Hydrostatic Forces on Plane Surfaces, Hydrostatic Forces on Curved Surfaces, Pressure Distribution in Rigid-Body Motion.

UNIT 3. BOUYANCY

Buoyancy and Stability

UNIT 4. FUNDAMENTAL LAWS OF FLUIDS IN MOTION

Introduction to Fluids in Motion, Bernouilli Equation, The Reynolds Transport Theorem, Conservation of Mass, Momentum Equation.

UNIT 5. FLOW IN PIPE SYSTEMS

Steady Uniform Flow in Pipes. Reynolds Number Regimes. Laminar Pipe Flow. Turbulent Pipe Flow. Dimensional Analysis. Friction Losses. Minor Losses. Analysis of Pipe Systems.

UNIT 6. FLOW IN OPEN CHANNELS

Open Channel Flow. Open Channel Flow. Uniform Flow. Efficient Uniform-Flow Channels. Specific Energy: Critical Depth. Momentum. Hydraulic Jump. Gradually

UNIT 7. LABORATORY

7939 Calculus II

PART I. CALCULATION OF MULTI-VARIABLE FUNCTIONS

TOPIC 1. MULTI-VARIABLE FUNCTIONS - DIFFERENTIAL CALCULUS

Basic definitions. Real function of several variables. Limits and continuity. Partial derivatives. Differentiation. Tangent plane to a surface at a point. Vector functions of several variables. Chain rule. Relative extremes. Absolute extremes. Conditioned extremes.

TOPIC 2. MULTIPLE INTEGRALS - APPLICATIONS

Double integrals: geometric interpretation and variable change. Triple integrals. Variable change. Plane and spatial applications: centres of mass and moments of inertia. Momentum of Inertia.

PART II. DIFFERENTIAL EQUATIONS

TOPIC 3. FIRST-ORDER DIFFERENTIAL EQUATIONS

Basic concepts. First-order differential equations resolvable with respect to y'. First-order differential equations not resolvable with respect to y'. Orthogonal existence and uniqueness theorem.

TOPIC 4. FIRST-ORDER DIFFERENTIAL EQUATIONS

Basic concepts. Higher order homogenous linear ODE. Higher order complete linear ODE.

TOPIC 5. COMPLETE LINEAR DIFFERENTIAL EQUATION SYSTEMS

Basic concepts. Homogeneous linear SODE. Complete linear SODE.

7940 Installations I

PART I. SUPPLY OF WATER

FUNDAMENTAL KNOWLEDGE

UNIT 1. WATER. TREATMENT

Introduction.
The consumption of water.
Water Treatment.

UNIT 2. WATER SUPPLIES

Mains network.
Distribution networks.
Connection and supply points.

UNIT 3. WATER SUPPLY (Section HS 4)

Scope of application.
Verification Procedure.

UNIT 4. CHARACTERIZATION AND QUANTIFICATION OF DEMAND

Installation Properties.
Signage.
Water saving.

UNIT 5. MATERIALS USED IN INTERIOR DOMESTIC DRINKING WATER INSTALLATIONS.

General conditions of materials.
General conditions of water pipes.
Valves and faucets.
Incompatibility between materials.

Faucets, sanitary and domestic apparatus.

UNIT 6. DESIGN AND REFRAMING OF INTERIOR INSTALLATIONS

General scheme of the installation.
Elements that compose the installations.
Protection against returns.
Separation from other facilities.
Signage.
Water saving.

UNIT 7. CALCULATION AND DIMENSIONING OF INTERIOR FACILITIES

Reserve of space in the building.
8.2. Calculation and dimensioning of the main networks.
8.3. Calculation and dimensioning of the derivations to wet rooms and branches.
Calculation and dimensioning of the DHW networks.
Calculation of expansions.
Calculation and dimensioning of the equipment, elements and devices of the installation.
Calculation and dimensioning of the installations with flux meter.

UNIT 8. CONSTRUCTION AND COMMISSIONING

General conditions of execution.
Installation tests.

UNIT 9. MAINTENANCE AND CONSERVATION

Service Interruption.
Re-commissioning.
General maintenance conditions.

UNIT 10. MINIMUM SOLAR CONTRIBUTION OF DOMESTIC HOT WATER

Minimum solar contribution.

UNIT 11. CALCULATION AND DIMENSIONING

Previous data.
General conditions of the installations.
General calculation criterion.
Components.
Orientation and tilt losses and shadows

UNIT 12. MAINTENANCE

Monitoring and maintenance Plan

PART II. WATER EVACUATION, CHARACTERIZATION AND QUANTIFICATION OF REQUIREMENTS

UNIT 13. MATERIALS USED IN WATER EVACUATION INSTALLATIONS

General characteristics of the materials.
Pipeline materials and collection points.
Conditions of accessory materials.

UNIT 14. DESIGN AND LAYOUT OF WATER EVACUATION INSTALLATIONS

General evacuation conditions.
General conditions of evacuation systems.
Elements that compose evacuation installations.

UNIT 15. CALCULATION AND DIMENSIONING OF EVACUATION INSTALLATIONS

Sizing of the sewage network.
Sizing of the rainwater network.
Sizing of mixed type collectors.
Sizing of ventilation grids.
Sizing of pumping and elevation systems.

PART III. WORKSHOP AND LABORATORY PRACTICES

- Water consumption apparatuses: toilets and domestic appliances.
- Metal pipes and fittings.
- Plastic pipes and fittings.

- Valves, mechanisms and accessories.
- Pressure groups. Pressure reducing valve.
- Inner installations: impermeability tests.
- Heat generators for DHW production.
- Pipes and accessories for evacuation and ventilation network.
- Domestic sanitary devices and taps.

7941 Legal aspects of building

THEORY, UNIT 1: FUNCTIONING OF THE ADMINISTRATION

TOPIC 1. GOVERNING PRINCIPLES OF ADMINISTRATION

- Legality Principle.
- Administration Privileges.
- Administration Duties.

TOPIC 2. THE ADMINISTRATIVE ACT

- Elements.
- Effectiveness.
- Administrative silence.

TOPIC 3. THE ADMINISTRATIVE PROCEDURE

- General principles.
- Interested parties.
- Structure.
- Deadlines.

TOPIC 4. ADMINISTRATIVE RESOURCES

- Concept and Principles.
- Types.

TOPIC 5. ADMINISTRATION GOODS

- Classification.
- Acquisition.
- Transmission.
- Self-protection.
- Exemption from seizure.

PRACTICE UNIT 1

TOPIC 1. LEGAL REGIME OF THE PUBLIC DOMAIN

- Highway Law.
- Water law.
- Coastal Law.
- Practical assumption of limitations to building in areas near the publicly owned land.

TOPIC 2. FORCED EXPROPRIATION

- Causa Expropiandi.
- Subjects.
- Procedure.
- Reversion.
- Practical case of forced expropriation.

TOPIC 3. ADMINISTRATIVE PROCEDURE

Practical case of administrative procedure and administrative appeals.

THEORY, UNIT 2: BUILDING WORKS

TOPIC 6. LEGAL STATUS OF THE AGENTS INVOLVED IN THE BUILDING WORK

- Types of Building Work.
- Applicable Regulations.
- Functions and Obligations of Agents.

TOPIC 7. CONTRACTING IN PRIVATE CONSTRUCTION WORK

- Work Contract.
- Service Contract.

TOPIC 8. PUBLIC PROCUREMENT

Legal regulation

- Contract Requirements.
- Contracting Procedure.
- Execution.
- Irregularities.
- Extinction.

TOPIC 9. AGENT RESPONSIBILITIES

Civil liability.

- Contractual.
- Extracontractual.

Criminal liability.

PRACTICE UNIT 2. THE BUILDING SITE

TOPIC 10. STEPS TO BE TAKEN ON-SITE

> Previous.

> For the Beginning of the Work.

> During the work.

- Daily.
- Monthly.
- Other Contingencies.

> Final managements.

> Later.

TOPIC 11. THE WORK PROGRAM AND THE BUILDING BOOK

- Guidelines and examples of a work program and its possible modification during the course of the project.
- Guidelines and example of the Building Records Book.

TOPIC 12. EASEMENTS.

> Introduction.
> Concept.
> Legal system.
> Legal easements.

- Necessary thoroughfare.
- Lights and Views.
- Centre islands.
- Others.

7942 Economics and business

PART I.

UNIT 1. ECONOMICS AND ECONOMIC ANALYSIS

- Concept of economics. Scarcity and choice.
- Economic activity.
- The circular flow of income.
- The frontier of production possibilities.

UNIT 2. BUSINESS AND THE MARKET

- The market.
- Demand.
- Supply.
- Market equilibrium.
- Supply and demand curves.
- Calculation of the demand curve.
- Displacements of the demand curve.
- Changes in prices and the elasticity of demand.

UNIT 3. COST ANALYSIS

- Cost Accounting.
- Cost and types of costs.
- Cost Model - volume – profit.
- Fundamental phases in cost analysis.
- Personnel costs.
- Material Costs.
- Indirect costs.

UNIT 4. VALUATION OF INVESTMENTS

- Investment and financing.
- Types of investments.
- Investment Valuation.
- Timeless criteria.
- Net cash Flow per committed monetary unit.
- Average annual net cash flow.
- Pay-back period.

Time criteria.

- Net present Value (NPV).
- Internal rate of return (IRR).
- Relationship between the NPV and the IRR criteria.

UNIT 5. FUNCTIONS OF BUSINESS ADMINISTRATION

- Planning.
- Organization. Organizational charts of the company.
- Directing.
- Personnel Integration.
- Supervising.

UNIT 6. THE CONSTRUCTION SECTOR

The construction sector. Economic magnitudes of the sector.

UNIT 7. STEPS TO CREATE A COMPANY

- Administrative steps.
- Plan of company.

PART II:

UNIT 8. ACCOUNTING

- Accounting.
- The balance.
- The books.
- Economic and Financial structure.
- Expenses and Income.
- Profit and loss account.
- General accounting plan. Accounting principles and standards.
- VAT.
- Stocks and adjustments.
- Weighted Average price.
- FIFO.
- LIFO.
- Depreciation of assets.
- Linear.
- Tables.
- Diminishing depreciation with constant depreciation.
- Diminishing depreciation of sum of digits.
- Activity-based.
- Wages and salaries.
- Differences from the General Construction Accounting Plan.
- Construction work accounting.
- Construction work executed by us for us.
- Construction work executed by others for us.
- Construction work executed by us to sell.
- Executed work units at the established prices.
- Construction work executed based on costs
- Fulfilled contract Method.
- Loan repayment.
- American.
- French.

- Constant quotas.
- Balance sheet analysis.
- Distribution of profits.
- Losses.
- Ratios. Profitability, liquidity and activity.

7943 Architectural drawing II

UNIT 1. SKETCHES AND SUBSEQUENT REPRESENTATION ON A SCALE OF SOLUTIONS, ELEMENTS AND DETAILS OF ARCHITECTURE.

Analyses and graphical expression applied to perception, knowledge and the representation of spaces, forms and architectural elements. Drawing up of plans. Sketching, data acquisition and drawing to scale. Application of representation systems.

UNIT 2. BASIC GRAPHICAL DOCUMENTATION OF THE ARCHITECTURAL PROJECT.

Graphical analysis of the architectural project at basic level. Project sketches. Elaboration of the graphic documentation of the project at basic level. Volumetric studies.

UNIT 3. REPRESENTATION PROCEDURES AND TECHNIQUES.

Standardization, symbology and representative conventionalisms. Graphic techniques and means of representation. Manual procedures and application of digital tools: AutoCAD, Sketchup and BIM-Revit environment.

7944 Topography

UNIT 1. INTRODUCTION TO TOPOGRAPHY.

1.1 Notions of Topography.
1.2 Notions of Geodesy.
1.3 Notions of Cartography.
1.4 Topographic concepts.

UNIT 2. MEASUREMENT UNITS AND TOPOGRAPHIC REPRESENTATION SYSTEMS.

2.1 Units of measure. Angles. Scales.
2.2 Representation systems.
2.3 Errors.

UNIT 3. TOPOGRAPHIC INSTRUMENTS.

UNIT 4. SURVEYS. TOPOGRAPHIC METHODS.

4.1 Altimetry methods
4.2 Planimetric methods.
4.3 Tachometry.

UNIT 5. TOPOGRAPHIC APPLICATIONS TO ENGINEERING PROJECTS.

UNIT 6. LAY OUTS.

7945 Computer- aided structural design

TOPIC I. INTRODUCTION
Historical introduction to the structure analysis and the Matrix Method

TOPIC II. BASES OF ANALYSIS
Hypothesis, Notation, Reference Systems, Stiffness Matrix and Matrix Approach.

TOPIC III. 2D TRUSS STRUCTURES
Degrees of Freedom by Node, Stiffness Matrix of a Truss element

TOPIC IV. 2D BEAM STRUCTURES.
Degrees of Freedom by Node, Stiffness Matrix of a Truss element

TOPIC V. 2D BEAM STRUCTURES.
Degrees of Freedom by Node, Stiffness Matrix of a Beam element

TOPIC VI. LOADS IN BEAMS.
Treatment of loads in beams and its transformation to node loads

TOPIC VII. MATRIX APPLICATION OF SYMMETRY AND ANTIMETRY.
Concept of Symmetry, Antimetry, and its application in Matrix method

TOPIC VIII. BOUNDARY CONDITIONS.
Fixed Supports, Settlement of supports and Elastic Supports.

TOPIC IX. MIXED STRUCTURES.
Structures with hinges.

TOPIC X. 3D STRUCTURES
General Treatment of 3D Truss and Beam Structures.

TOPIC XI. MATRIX APPLICATION TO LINES OF INFLUENCE.
Concept of Line of Influence. Sign Criteria. Reciprocity Theorem. Matrix Application to the calculation of Lines of Influence

ANNEX: SYSTEMS OF EQUATIONS RESOLUTION
Analysis of the Differences Methods for the Resolution of Systems of Equations.

7946 Hydrology

UNIT 1. INTRODUCTION

- Introduction to Hydrological Science
- Hydrological Cycle
- Watershed and Hydrologic systems

UNIT 2. SURFACE HYDROLOGY

- Precipitation
- Evaporation: evaporation processes. Soil water balance
- Runoff process and Infiltration
- Watershed response
- Flood frequency analysis

UNIT 3. GROUNDWATER

- Movement of water in permeable mediums
- Groundwater hydraulics

UNIT 4. HYDROLOGICAL MODELING

- Introduction to modeling with HEC-HMS
- SIG

7947 Electrotechnics

UNIT 1. ELECTRICAL CIRCUITS

- **THEORY OF ELECTRICAL CIRCUITS**
- **ALTERNATING CURRENT CIRCUITS**
- **THREE-PHASE CIRCUITS**

UNIT 2. ELECTRICAL MACHINES

- **GENERAL PRINCIPLES OF ELECTRICAL MACHINES**
- **TRANSFORMERS**
- **ASYNCHRONOUS OR INDUCTION MACHINES**
- **SYNCHRONOUS MACHINES AND GENERATOR SETS**
- **DIRECT CURRENT AND SPECIAL MACHINES**

UNIT 3. ELECTRICAL INSTALLATIONS

- **ELECTRICAL POWER SYSTEMS IN INSTALLATIONS IN CIVIL WORKS**
- **ELECTRICAL TECHNOLOGY APPLIED TO INSTALLATIONS IN CIVIL WORKS**

UNIT 4. LABORATORY PRACTICES

- **NOTIONS OF ELECTROMETRY**
- **ELECTRICAL ELEMENTS**
- **MEASUREMENT OF CURRENT, VOLTAGE AND POWER**

- **PROOF OF LAWS AND THEOREMS**
- **ALTERNATING CURRENT CIRCUITS**
- **THREE PHASE CIRCUITS**
- **TRANSFORMERS**
- **ASYNCHRONOUS OR INDUCTION MACHINES**
- **SYNCHRONOUS MACHINES AND GENERATING SETS**
- **ELECTRICAL TECHNOLOGY APPLIED TO CIVIL WORKS FACILITIES**

7948 Installations II

BLOCK 1. AIR CONDITIONING

TOPIC 1. FUNDAMENTAL CONCEPTS OF THERMODYNAMICS

- Heat and temperature
- Thermometric scales.
- Latent heat and sensible heat.
- Heat Propagation: conduction, convection and radiation.
- Air Characteristics.

TOPIC 2. AIR CONDITIONING FACILITIES

- General information
- Types of air conditioning systems.
- Comfort Parameters: hydrothermal well-being indices.

TOPIC 3. CALCULATION OF THERMAL TRANSMITTANCE

- Thermal conductivity Coefficient.
- Most used Materials and their characteristics.
- Internal thermal resistance.
- Superficial thermal resistance.
- Total thermal resistance.
- Thermal transmittance.

TOPIC 4. CALCULATION OF THE CHARACTERISTIC PARAMETERS OF DEMAND

- Thermal transmittance of enclosures in contact with the outside.
- Thermal transmittance of soil in contact with the ground.
- Thermal transmittance of walls in contact with the ground.
- Thermal transmittance of buried roofs.
- Thermal transmittance of inner partitions.
- Thermal transmittance of sanitary chambers.
- Thermal transmittance of openings and skylights.
- Solar factor of openings and skylights.

TOPIC 5. SURFACE AND INTERSTITIAL CONDENSATION

- Conditions for the calculation of condensation.
- Calculation of surface condensation.
- Checking interstitial condensation.
- Calculation of interstitial condensation.
- Temperature Distribution.
- Saturation steam pressure distribution
- Steam pressure distribution

TOPIC 6. LIMITATION OF ENERGY DEMAND

- General information.
- Characterization and quantification of requirements.
- Calculation and dimensioning.
- Construction products.
- Construction.

TOPIC 7. JUSTIFICATION SHEETS FOR THE SIMPLIFIED OPTION

- Sheet 1-Calculation of the average characteristic mean parameters.
- Sheet 2- Energy demand conformance.
- Sheet 3- Condensation conformance.

TOPIC 8. DESIGN AND CALCULATION OF AIR CONDITIONING FACILITIES BY VENTILATION

- Indoor air quality in homes (HS3).
- Air quality in the tertiary sector (HE2-RITE).

TOPIC 9. THERMAL LOADS (HEATING)

- Inner and outer calculation conditions.
- Heat load by transmission.
- Heat load by ventilation.
- Calculation table of the total thermal load and of each property.

TOPIC 10. THERMAL LOADS (REFRIGERATION)

- Internal and external calculation conditions.
- Heat load by transmission and solar radiation.
- Ventilation heat load.
- Internal load per person, illumination etc.
- Calculation table of the total thermal load and of each property.
-

TOPIC 11. DESIGN AND CALCULATION OF SUMMER AIR CONDITIONING INSTALLATIONS (COOLING)

- Classification of air conditioning systems in summer.
- Air distribution networks.
- Terminal elements.
- Hydraulic circuits.
- Calculation of cooling plant elements.
- Schemes. Regulation and control.
- Operation and implementation.

TOPIC 12. RADIANT HEATING AND COOLING FLOORS

- Characteristics of the installation.
- Calculation and design.
- Regulation and control.
- Implementation.

BLOCK 2 WORKSHOP AND LABORATORY PRACTICES

7949 Construction IV

CHAPTER 1 - STRUCTURES WITH STONE MATERIALS (QUARRYING)

TOPIC 1 - QUARRYING

1.1 Definition.
1.2 Extraction of the stone.
1.3 Bonding and union materials.
1.4 Tools, equipment and auxiliary means.
1.5 Joints, repointing and reworking.
1.6 Stone finishes.
1.7 Classification of quarry pieces.
1.8 Masonry construction work.
1.9 Ashlar construction work.
1.10 Ashlar masonry construction work.
1.11 Platings or coatings.
1.12 Tiles or pavers.

TOPIC 2 – MASONRY AND ASHLAR CONSTRUCTION WORK

1. Definition
2. Classification.
3. Ordinary stonework.
4. Ashlar masonry.
5. Masonry with pebbles.

6. Gravel Masonry.
7. Rubble Masonry.
8. Masonry with irregular courses.
9. Masonry with regular courses or ashlar.
10. Polygonal masonry.
11. Construction details
12. Mixed masonry.

TOPIC 3 - ASHLAR MASONRY CONSTRUCTION WORK

1. Definition and general information.
2. Classification of ashlars.
3. Types of ashlar masonry.
4. Division of the work.
5. Obtaining ashlar blocks. Cutting ashlar blocks.
6. Bedding ashlar.
7. On-site casting of bonds.
8. Fully bonded footing.
9. Bonding.
10. Racked.
11. Junction.
12. Circular.

TOPIC 4 - STONE STAIRCASES

1. Classification.
2. Straight self-supporting staircases.
3. Curved self-supporting staircases.
4. Helicoidal or spiral staircases.

TOPIC 5 - ARCHES

1. Constituent Elements.
2. Surfaces relative to the arch.
3. Linear Dimensions.
4. Execution of an arch in natural stone.
5. Working the jambs.
6. Layout of the arch mount.
7. Forming the voussoirs.
8. Placing the jambs.
9. Shoring systems and trusses.
10. Assembly process.

TOPIC 6 - LINTELS, GUTTERS AND COPINGS

1. Lintels by means of segments.
2. Lintels by means of whole stones.
3. Gutters.
4. Copings.

CHAPTER 2 - WOODEN STRUCTURES (CARPENTRY TO ASSEMBLE)

TOPIC 1 - CARPENTRY TO ASSEMBLE

1.1.-Introduction.
1.2. - Classification of carpentry work.
1.3. Materials.
1.4. - Microscopic Structure of the wood.
1.5. - Properties of wood.
1.5.1. - Anisotropic material.
1.5.2. - Mechanical characteristics.
1.5.3. - Humidity of wood.
1.6. - Pathology and protection.
1.6.1. - Destructive Agents.
1.6.2. - Preventive and curative actions.
1.6.3. - Constructive protection measures.
1.6.4. - Replacement and rehabilitation of wooden structures.
1.7. - Fire in wooden structures.
1.7.1. - Behaviour of wood against fire.
1.7.2. - Fire protection.
1.8. - Tools and machinery.

TOPIC 2 - JOINTS

2.1. - Introduction.
2.2. - Classification.
2.3. - Traditional or carpenters' joints.
2.3.1. – Lap joints.
2.3.2. – Couplings.
2.3.3. – Assemblies.
2.3.4. - Auxiliary elements for joining wood.
2.3. - Modern Joints.
2.3.1. – Pegged joints.
2.3.2. – Connector joints.
2.4. - Glued joints.
2.5. - Auxiliary elements.
2.6. – On-site placement and installation.

TOPIC 3 - WOOD PRODUCTS

3.1. - Introduction.
3.2. - Laminated Wood.
3.2.1. – Glues.

3.2.2. – Wood.
3.2.3. - Joints of sheets.
3.2.4. - Manufacture of glued beams.
3.3. - Boards
3.3.1. - Solid wood Board.
3.3.2. - Plywood Board.
3.3.3. - Laminated core board.
3.3.4. - Particle Board.
3.3.5. – Fibreboard.
3.3.6. - Complex Board.
3.3.7. - Honeycombed Board.
3.3.8. - Physical characteristics.
3.3.9. - Mechanical characteristics.
3.3.10. - Rules of implementation.

TOPIC 4 - SOLID WOOD CONSTRUCTIONS

4.1. - Constructions with logs or timber.
4.1.1. – Characteristics.
4.1.2. – Foundations.
4.1.3. – Walls.
4.1.4. – Divisions.
4.2. - Vertical Latticework.
4.2.1. – Characteristics.
4.2.2. - Classification.
4.2.3. - Execution process.
4.2.4. - Construction details.
4.3. - Horizontal truss work.
4.3.1. – Characteristics.
4.3.2. - Construction details.
4.4. - Inclined truss work.
4.4.1. – Characteristics.
4.4.2. – Lean-to roof.
4.4.3. – Ridge loaded roof.
4.4.4. – Couple roof.
4.4.5. – Ridge loaded roof with braced purloins and king post.
4.4.6. – Roof frames with posts.
4.4.7. – Purlin roof frames.
4.4.8. – Mansard roof.
4.4.9. – Roof with a garret.
4.4.10. - Saw tooth roof or shed.
4.4.11. - Tower and pavilion roofs.
4.4.12. - Intersection and penetration of roofs.
4.4.13. – Attics.
4.4.14. - Single-pitched roofs.
4.5. - Wooden Staircases.
4.5.1. – Ladder stairs.
4.5.2. - Fitted or assembled Staircases.

4.5.3. - Supported Staircases.
4.5.4. - Curved Staircases.

TOPIC 5 - LIGHT-FRAME CONSTRUCTIONS

5.1. - Introduction.
5.2. - Structural Elements.
5.2.1. – Foundations.
5.2.2. – Facades.
5.2.2.1. – Framework by storeys.
5.2.2.2. - Framework with continuous straight footings.
5.2.2.3. - Overlaps, corners and openings.
5.2.2.4. - Exterior cladding.
5.2.3. – Slabs.
5.2.4. - Interior Partitions.
5.2.5. – Roofs.
5.2.6. - Interior finishes.
5.2.7. – Facilities.
5.3. - Constructive process.

TOPIC 6 - SPECIAL WOODEN CONSTRUCTIONS

6.1. - Solid core structures.
6.2.1. - Hollow Beams.
6.2.2. - Beams with double T section.
6.2.3. - Web plate beams.
6.2.4. – Beams with web openings.
6.2. – Structures with bar frameworks.
6.2.1. - Beams with wooden bars.
6.2.2. - Triangular reinforcement.
6.2.3. - Parallel cord lattice beams
6.3. - Portals
6.3.1. - Lattice frame portals
6.3.2. - Hollow core and double-T frame portals.
6.3.3. - Laminated wood frames.
6.4. – Arches.
6.5. - Laminated wooden Structures.
6.5.1. - Introduction.
6.5.2. - Constituent elements.
6.5.3. - Structural typology.

6.5.4. - Fields of application.

TOPIC 7 - EXECUTION

7.1. - General principles.
7.2. - Construction details.

7.3. – Tolerances.
7.4. – Control.

CHAPTER 3 - METALLIC STRUCTURES

TOPIC 1 - METAL CONSTRUCTIONS

1.1. - Introduction.
1.2. - Advantages and disadvantages of metallic structures.
1.3. – Structural steel.
1.4. - Steel in the Technical Code.
1.5. - Specifications of qualities and grades.
1.6. - Applications for the different types of steel.
1.7. – Profiles.
1.8. - Other products.
1.9. – Applications.
1.10. - Manufacturing Process.
1.11. - Typology of structures.
1.12. - Basic document of Steel structures.

TOPIC 2 – TYPES OF JOINT

2.1. - INTRODUCTION.
2.2. – RIVETS.
2.3. - ORDINARY AND CALIBRATED SCREWS.
2.4. - HIGH RESISTANCE SCREWS.
2.5. - PREPARATION OF HOLES.
2.6. - CONSTRUCTION ARRANGEMENTS.
2.7. – EXECUTION.
2.8. – WELDING.
2.8.1. - Fusion welding.
2.8.2. - Electric Arc welding.
2.8.3. - Electric resistance welding.
2.8.4. - Deformations and residual stresses.
2.8.5. - Classification of welds.
2.8.6. - Instructions for welding.
2.8.7. - Imperfections in welded joints.
2.8.8. - Sources of energy for welding.
2.8.9. - Welding accessories.
2.8.10. – Tools.
2.8.11. - Work Clothes.
2.8.12. - Safety and hygiene.

TOPIC 3 - STEEL CUTTING

3.1. - CUTTING WITH GASES

3.1.1. – Fundamentals.
3.1.2. - The blowtorch.
3.1.3. – Defects.
3.2. - CUTTING WITH THE ELECTRIC ARC
3.2.1. - With hollow electrode.
3.2.2. - With carbon electrode.
3.2.3. - Under protective gas.
3.1. - CUTTING WITH PLASMA.
3.3.1. – Foundation.
3.3.2. – Modalities.
3.3.3. – Applications.
3.3.4. – Defects.
3.4. - CUTTING WITH LASER.
3.5. - OTHER PROCEDURES.

TOPIC 4 - METAL LATTICE FRAMEWORK CONSTRUCTIONS

4.1. - Introduction.
4.2. - Structural Configuration.
4.2.1. – Configuration.
4.2.2. - Interaction with soil.
4.2.3. - Typology of ties.
4.3. - Structural Elements.
4.3.1. – Columns.
4.3.2. – Girders.
4.3.3. – Cross braces.
4.4. - Construction details. Joints.
4.4.1. - Column-foundation joint.
4.4.2. - Girder-column joint.
4.4.3. - Column-column joint.
4.4.4. - Girder-girder joint.
4.4.5. - Masonry supports.
4.4.6. – Girder-slab joint.
4.4.7. - General Cross bracing.
4.4.8. - Profile joints.
4.5. - Execution process.

TOPIC 5 - LARGE SPAN METAL CONSTRUCTIONS

5.1. - Introduction.
5.2. - Structural Typology.
5.2.1. - Flat reinforcement Structures.
5.2.1.1. – Framework structures.
5.2.1.2. – Portal frames.
5.2.1.3. – Arches.
5.2.2. - Tubular Profiles.
5.2.2.1. - Introduction.
5.2.2.2. - Advantages and disadvantages.

5.2.2.3. – Applications.
5.2.2.4. – Joints.
5.2.2.5. – Pathologies.
5.2.3. - Spatial Structures.
5.2.3.1. – Composition.
5.2.3.2. – Bar joints.
5.2.3.3. – Support.
5.3. - Execution process.

TOPIC 6 - METAL STAIRCASES

6.1. - General information.
6.2. - All-metal Staircases.
6.3. - Mixed steel-concrete staircases.

TOPIC 7 - STEEL AND CONCRETE STRUCTURES

7.1. - Introduction.
7.2. - Metallic Supports for reinforced concrete slabs.
7.3. - Mixed steel-concrete structures.
7.3.1. – Supports.
7.3.2. – Girders.
7.3.3. - Construction details.
74. – Pre-stressed steel beams.
7.5. - Collaborative slabs.

TOPIC 8 - METAL CONSTRUCTION PROTECTION

8.1. - Introduction.
8.2. – Corrosion.
8.2.1. - Introduction.
8.2.2. - Protection Systems.
8.2.1.1. - Concrete coating.
8.2.1.2. – Metallic plating.
8.2.1.3. - Paint Systems. Reference standards.
8.2.1.4. – Other.
8.3. – Fire resistance.
8.3.1. - Steel exposed to fire.
8.3.2. - Fire safety.
8.3.3. - Protection systems.
8.3.4- Reference standards.

TOPIC 9 - TOLERANCES AND CONTROL OF METAL CONSTRUCTIONS

9.1. - Introduction.
9.2. - Manufacturing tolerances.
9.3. – On-site placement tolerances.

TOPIC 10 - CONTROL OF METAL CONSTRUCTIONS. INSPECTION AND MAINTENANCE

10.1. - Introduction.
10.2. - Quality Control of the project.
10.3. - Control of materials.
10.4. - Control of completed work.
10.4.1. - Control of the work executed in the workshop and on-site.
10.4.2. - Inspection of metal constructions.
10.4.3. - Inspection of welds.
10.4.3.1. - Visual Inspection.
10.4.3.2. - Inspection by penetrating liquids.
10.4.3.3. - Irradiation Procedures.
10.4.3.4. - Ultrasound tests.
10.4.3.5. - Figuration tests.
10.5. - Inspection and maintenance.

7950 Architectural drawing III

PART I. BASIC GRAPHICAL DOCUMENTATION AND EXECUTION OF THE ARCHITECTURAL PROJECT.

UNIT 1. PLANIMETRIC PROJECT DOCUMENTATION.

General information and development.

UNIT 2. SCALES AND ARCHITECTONIC DETAIL.

Detail, scales and degrees of definition.

The scale in coherence with the need of the tectonic model and its adjustment to the degree of scalar definition.

UNIT 3. REPRESENTATION PROCEDURES AND TECHNIQUES.

Methodology and Manual graphical procedures and application of AutoCAD, Sketchup and Revit digital tools.

PART II. ELEMENTARY ARCHITECTONIC FACT AND TECTONIC DEVELOPMENT.

UNIT 4. PLANIMETRY OF EXECUTION OF ELEMENTARY ARCHITECTONIC UNIT.

Planimetric development of execution of elementary architectonic unit.

UNIT 5. DETAIL OF SIMPLE ARCHITECTURAL UNIT.

Detail development of elementary architectural unit.

UNIT 6. REPRESENTATION PROCEDURES AND TECHNIQUES.

Methodology and Manual graphical procedures and application of

AutoCAD, Sketchup and Revit software.

PART III. COMPLEX ARCHITECTONIC FACT AND TECTONIC DEVELOPMENT.

UNIT 7. PLANIMETRY OF COMPLEX ARCHITECTURAL UNIT

Development of the actual planimetry a complex architectural unit.

UNIT 8. DETAIL OF COMPLEX ARCHITECTURAL UNIT.

Detail development of complex architectural unit.

UNIT 9. REPRESENTATION PROCEDURES AND TECHNIQUES.

Methodology and Manual graphical procedures and rendering programs compatible

With the digital tools developed in the previous subjects taught in the area or 3D Max.

PART IV. IDEATION AND ARCHITECTURAL DETAIL.

UNIT 10. ARCHITECTURAL IDEATION AND PLANIMETRY

Development of planimetry in the ideation of architecture

UNIT 11. IDEATION AND ARCHITECTURAL DETAIL.

Development of architectural detail in the ideation of architecture.

UNIT 12. REPRESENTATION PROCEDURES AND TECHNIQUES

Methodology and Manual graphical procedures and rendering programs compatible with the digital tools developed in the previous subjects taught in the area or 3D Max

➢ Third year:

7951 Geotechnics

INTRODUCTION

1. What does geotechnical engineering mean?
2. Birth of modern geotechnical engineering
3. Definition of soil
4. Geotechnical uncertainties due to soil nature
5. Solution of a geotechnical problem
6. Syllabus

UNIT 1. PARTICLE SIZE DISTRIBUTION

1. Basic soil types in terms of the grain size ranges
2. Organic soils
3. Grain size distribution curves
4. Interpretation of grain size distribution curves

UNIT 2. PHASE RELATIONSHIPS

1. Soil identification
2. Phase relationships

UNIT 3. SOIL PLASTICITY AND SOIL CLASSIFICATION

1. Consistency of a soil (plasticity)
2. Sand equivalent test
3. Sand equivalent test
4. Atterberg limits
5. Soil classification

UNIT 4. CLAY PROPERTIES

1. Clay minerals

2. Clay particles (“double layer”, “adsorbed water”)
3. Degree of sensitivity and thixotropy
4. Clay structures

UNIT 5. SOIL WATER AND SOIL HYDRAULICS

1. Soil-water geometry
2. state
3. Flow of soil water
4. Analysis of 2-dimensional flow in porous media.
5. Flow nets
6. Effects of seepage

UNIT 6. FUNDAMENTALS OF CONTINUUM MECHANICS

1. Physical model on an interparticle contact plane
2. principle of effective stress
3. The state of stress
4. Mohr circles
5. Principal stresses

UNIT 7. ONE-DIMENSIONAL CONSOLIDATION SETTLEMENT OF FINEGRAINED SOILS

1. Introduction to the hydrodynamic nature of the settlement
2. The oedometer apparatus. Oedometer test
3. Normally consolidated and overconsolidated clays
4. Secondary consolidation
5. Initial consolidation
6. Oedometric and elastic moduli
7. Settlement estimation
8. Terzaghi-Fröhlich consolidation theory

UNIT 8. STRESSES AND STRAINS IN SOILS. ELASTIC DEFORMATION THEORY

1. Stresses in an elastic, homogenous and isotropic space
2. Settlement estimation according to the elastic deformation theory
3. Introduction to complex loads and anisotropic soils
4. Settlement analysis

UNIT 9. SOIL COMPACTION

1. Introduction: definitions
2. Types of compaction effort and types of compaction equipment
3. Dry density-Water content curve
4. Compaction tests
5. Degree of compaction
6. Compaction quality assurance
7. Soil collapse
8. Soil expansivity (swelling)

1. Introduction: definitions
2. Description of shear tests
3. Mohr-Coulomb failure model
4. Most common shear tests
5. Lambe´s parameters
6. Stress paths

UNIT 11. LATERAL EARTH PRESSURE

1. Rankine earth pressure theory

UNIT 12. SHALLOW FOUNDATIONS

1. Definition of foundation
2. Types of foundations
3. Verifications for foundation design
   3.1 Location
   3.2 Ultimate bearing capacity
   3.3 Settlement analysis

UNIT 13. PILE FOUNDATIONS

1. Types of piles
2. Uses of piles
3. Precast concrete piles
4. Cast-in-place concrete piles
5. Single pile load capacity

LABORATORY AND IN-SITU TESTS

Physical and index properties of a soil. Atterberg Limits. Particle size distribution: methods of sieving and sedimentation. Permeability tests. Static (seepage-induced) liquefaction tests. Proctor tests. One-dimensional consolidation tests. Direct shear tests. Unconfined compression tests. Triaxial tests. Possible technical visits to geotechnical constructions.

7652 Transports

1. TRANSPORTATION MODES

- ROAD TRANSPORT
- RAIL TRANSPORT
- AIR TRANSPORT
- MARITIME TRANSPORT
- URBAN TRANSPORT
- INTERMODAL TRANSPORT

2. INTRODUCTION TO TRANSPORT PLANNING

- TRANSPORT PLANNING
- ACCESIBILITY
- TRANSPORT DEMAND

7953 Materials II

THEMATIC UNIT 1. GRANULOMETRY

TOPIC 1. CLASSIFICATION OF AGGREGATES.

Introduction. Classification and designation of aggregates. Aggregates for concrete. Particle size (granulometry) problems.

THEMATIC UNIT 2. MATERIALS USED IN THE MANUFACTURING OF CONGLOMERATES

TOPIC 1. CONGLOMERATES

Introduction. Cements.

TOPIC 2. WATER

Introduction. Characteristics of water for use in conglomerates. Mix water. Curing water. Water for washing aggregates.

TOPIC 3. ADDITIVES

Introduction. Classification. Plasticizers. Superplasticizers. Aerators. Modifiers for setting and hardening. Very water-repellent. Gas generators. Foam generators. Colorants. Additions

THEMATIC UNIT 3. CONGLOMERATES. CONCRETE

TOPIC 1. INTRODUCTION TO CONCRETE

Introduction. History of Portland concrete.

TOPIC 2. CEMENTS FOR CONCRETES

Introduction. History of Portland cement. Composition of Portland cement.

Manufacture of Portland cement. Fineness of grinding. Loss to fire and insoluble hydration of Portland cement. Portland cement setting and Portland cement expansion. Cement shrinkage and stiffening. Cement resistance. Types of cements. Classification of cements according to RC-08. Usable cements according to EHE-08

TOPIC 3. AGGREGATES FOR CONCRETE

Introduction. Nature and origin of aggregates. Designation of aggregates.

Characteristics of aggregates. Granulometric study of aggregates.

TOPIC 4. FRESH CONCRETE

Introduction. Properties. Consistency. Measure of consistency. Docility. Homogeneity. Specific weight. Compactness.

TOPIC 5. DOSAGE OF CONCRETE

Introduction. General requirements. Fuller method. Bolomey method. De La Peña method.

TOPIC 6. MANUFACTURE, TRANSPORT AND PLACING OF CONCRETE

CONCRETE

Introduction. Concrete manufacture. Concrete transport. Designation and characteristics

Placing of concrete. Concrete consolidation.

Concrete joints. Precautions to be taken when placing concrete in cold or hot weather.

TOPIC 7. CURING AND PROTECTION OF CONCRETE

Introduction. Fictitious age and degree of maturity. Concrete curing. Influence of curing on the

Types of curing. Concrete protection.

TOPIC 8. PHYSICAL CHARACTERISTICS OF HARDENED CONCRETE

Introduction. Density. Elasticity. Resistance to compression. Resistance to traction.

Permeability. Shrinkage and stiffening. Fluency. Thermal properties.

TOPIC 9. DURABILITY

Introduction. Classes of types of environments. Strategy for durability. Concrete dosage

Concrete impermeability. Physical actions. Chemical attacks. Expansive attacks. Concrete cracking.

TOPIC 10. SPECIAL CONCRETE

Introduction. Lightweight concrete. Heavy concrete. Refractory concrete. Concrete reinforced with fibres. Polymer-impregnated concrete. Sulphur-impregnated concrete. Concrete sealed with wax. Porous concrete. Roller-compacted dry concrete. Concrete and sprayed mortar.

High resistance concrete. Self-compacting concrete. Recycled concrete.

TOPIC 11. CONCRETE QUALITY CONTROL

General control criteria. Quality control levels. Conditions for compliance. Documentation and follow-up. Control of execution. Levels of guarantee and seals of quality.

TOPIC 12. CONCRETE DOSING PROBLEMS

TOPIC 13. LABORATORY PRACTICES

Determination of the wear resistance of coarse aggregates. “Los Angeles” abrasion test. Particle size trial of an aggregate. Determination of aggregate shape coefficient Determination of consistency. Abrams’ cone method. Manufacture of concrete specimens. Facing of specimens. Determination of resistance. Determination of resistance to indirect traction

Non-destructive tests. Sclerometric methods. Determination of resistance to compression by ultrasound.

THEMATIC UNIT 4. METALLIC PRODUCTS

TOPIC 1. GENERAL INFORMATION ON METALLIC MATERIALS

Introduction. Obtaining.

TOPIC 2. METALLIC MATERIAL PROPERTIES

Mechanical properties. Chemical properties. Thermal and electrical properties

TOPIC 3. METAL WORK

Types of work. Special treatments.

TOPIC 4. IRON AND STEEL

Metallurgy. Foundry: obtaining, composition and types. Steel: obtaining and FE-C diagrams. Phases. Commercial forms of iron and steel. Stainless steel.

TOPIC 5. STEEL FOR PASSIVE ARMATURES (EHE-08)

General information. Passive armatures. Weldable corrugated steel bars and rolls. Corrugated wire and smooth wire.

TOPIC 6. COPPER

General information. Properties. Uses. Copper tubes.

TOPIC 7. MAIN ALLOYS

Brass. Bronze.

TOPIC 8. ALUMINIUM

General information. Properties. Uses. Alloys.

TOPIC 9. ZINC

General information. Properties. Uses

TOPIC 10. GALVANIZED AND SHERARDIZED

General information. Types of galvanization. Commercial forms. Alloys.

TOPIC 11. LEAD

General information. Properties. Uses. Commercial forms. Alloys.

TOPIC 12. TESTS ON STEEL FOR CONCRETE

Sampling, identification and preparation of specimens for resistance to traction. Resistance to bending. Resistance to ungluing. Resistance to torsion. Resistance to penetration.

THEMATIC UNIT 5. WOOD

TOPIC 1. GENERAL INFORMATION ON WOOD

Advantages and disadvantages. Nature of wood.

TOPIC 2. MAIN TYPES OF WOOD USED IN CONSTRUCTION

Conifer wood. Hardwood. Exotic wood.

TOPIC 3. PHYSICAL AND MECHANICAL PROPERTIES OF WOOD

Physical properties. Mechanical properties.

TOPIC 4. WOOD TESTS

Moisture determination. Shrinkage determination. Hardness determination.

Determination of compressive strength. Determination of tensile strength.

Determination of resistance to cutting. Determination of bending strength.

TOPIC 5. DEFECTS AND ALTERATIONS OF WOOD

Knots. Twisted fibre. Interlaced fibre. Other defects.

TOPIC 6. DESTRUCTION OF WOOD

General information. Causes of destruction. Biotic causes. Abiotic causes.

TOPIC 7. PROTECTION OF WOOD

Protection of wood. Wood treatment.

TOPIC 8. RECOGNITION OF WOOD

FIRST, PART. THE SKIN OF THE BUILDING.

1. Introduction and general concepts.
1.1. General concepts. Program. Bibliography and regulations.
1.2. General Concepts of building enclosures.
1.2.1. External actions that affect the building.
1.2.2. User requirements
1.2.3. Classification of enclosures.

SECOND, PART. THE ROOF OF THE BUILDING.

2. The Roof. General concepts.
2.1. Definition and components of a roof.
2.2. Roof requirements.
2.2.1. Environmental.
2.2.2. Safety.
2.2.3. Aesthetics.
2.2.4. Durability.
2.3. Classification of roofs
3. FLAT ROOFS.
3.1. Types of flat roofs.
3.1.1. Non-transitable roof.
3.1.1. Transitable roof.
3.1.3. Landscaped roof.
3.1.4. Roof for road traffic.
3.1.5. Water roof.
3.2. The inverted roof.
3.2.1. Formation of slopes
3.2.2. Waterproofing.
3.2.3. Thermal insulation.
3.2.4. Separating layers.
3.2.5. Protective layers.
3.2.6. Water evacuation.
3.3. Execution of singular points.
4. Sloping roofs.
4.1. Introduction. Types.
4.2. Roof materials.
4.2.1. Loose parts.
4.2.2. Metallic sheets.
4.2.3. Plates.
4.2.4. Panels.
4.3. Thermal insulation.
4.4. Roof supports.
4.4.1. Lineal.
4.4.2. Surface.
4.5. Resistant structures.

4.6. Water drainage systems.
4.7. Constructive solutions for each type of roof.
4.8. Singular points.
5. Lighting on roofs.
5.1. Constructive requirements.
5.2. Skylights.
5.3. Light wells.
5.4. Composition Elements.
5.4.1. Glass.
5.4.2. Plastics.
5.4.3. Carpentries.
5.4.4. Joints and seals.
5.5. Singular points.
6. Execution and control of roofs.

THIRD PART. THE FACADE.

7. Conventional brickwork facades.
8. Ventilated facade.
9. Facade cladding.
9.1. Natural stone cladding
9.2. Ceramic tile cladding.
9.3. Continuous coatings
9.3.1. Rendering.
9.3.2. Stucco.
9.3.3. Complementary decorative work.
10. Lightweight facade panels.
10.1. GRC Panels.
10.2. Simple plate panels.
10.3. Sandwich Panels.
11. Heavy facade panels.
11.1. Concrete panels.
11.2. Glass. Curtain Wall.
12. Carpentries.
12.1. Wood.
12.2. Light alloys.
12.3. Plastics.
13. Defences.
13.1. Railings.
13.2. Closures.
13.3. Blinds.
13.4. Lattice blinds.
14. Glasswork.
14.1. Plans.
14.2. Tempered.
14.3. Special.

FOURTH PART. PARTITIONS.

15. Partition walls.
15.1. Brick.
15.2. Plates and panels.
16. Carpentry.
16.1. Wood.
16.2. Metals
16.3. Glass.

FIFTH PART. COATINGS.

17. Walls.
17.1. Plasters
17.2. Trimmings and plaster.
17.3. Stucco.
17.4. Tiling.
17.5. Veneers.
17.6. Flexible.
17.7. Lightweight.
17.8. Flexible.
17.9. Fabrics.
17.10. Paints.
18. Floors.
18.1. Floor tiles.
18.2. Hardwood floors.
18.3. Industrial.
18.4. Laminates.
18.5. Carpeting.
18.6. Stones.
18.7. Wall-plates.
18.8. Terrazzo.
19. Ceilings.
19.1. Continuous.
19.2. Plates.

7955 Structures analysis and reinforced concrete fundamentals

ANALYSIS OF STRUCTURES

1. Hyperstatic structures.
2. Flat systems.
3. Method of forces or flexibility.
4. Symmetry and anti-symmetry.
5. Mixed structures (rigid ties - articulated ties).
6. Seats, temperature variations, manufacturing errors.
7. Calculation Programs - CYPE Metal 3D, Tricalc by Arktec and/or others.
8. Introduction to rigidity and displacement methods.

FUNDAMENTALS OF REINFORCED CONCRETE

1. General principles.

Project Bases. Safety Criteria and calculation bases. Actions, materials and
Analysis of structures. Technological Properties of Materials.
Durability.

2. Calculation.

Material Data for the project. Calculations relating to the Last State Limits.
Equilibrium Limit State.

3. Fatigue Limit State vs. Normal solicitations (I).

General calculation principles. Calculation of reinforcement of sections subjected to simple bending in beam elements.

4. Fatigue Limit State vs. Normal solicitations (II).

Calculation of ultimate moments in cases of simple flexion.

5. Fatigue Limit State vs. Normal solicitations (III).

Calculation of reinforcement of sections subjected to simple bending in beam and column elements.

6. Fatigue Limit State vs. Shear stress.

Calculation of reinforcement in sections subjected to compound flexion in beam and column elements.

7. Instability Limit State.

Verification of isolated supports.

8. Deformation Limit State.

Simplified method.

9. CYPECAD. And/or Tricalc by Arktec.

7956 Quantity surveying I

UNIT 1. BUILDING PROJECT. DOCUMENTS
UNIT 2. BUDGET STRUCTURE
UNIT 3. WORK MEASUREMENTS AND VALUATIONS I

- **EARTHWORKS**
- **FOUNDATIONS**
- **STRUCTURES**
- **BRICKWORK**

7957 Construction equipment and auxiliary means

PART I. SITE PLANNING FOR WORK EQUIPMENT AND AUXILIARY MEANS

UNIT 1. CLASSIFICATION OF WORK EQUIPMENT

This lesson has as its objective the planning and placement of the different equipment and auxiliary means, differentiating the different elements that must be considered, in order to have the basic services before beginning construction or rehabilitation of any job.

UNIT 2. CONSIDERATION OF WORK EQUIPMENT

Within this lesson, the students will have as their objective to become familiar with the basic documentation of an architectural project as well as the study of the location of the equipment on-site.

This is because the construction process of any building is justified to develop in detail all the specific requirements of barriers with their typologies and administrative processes.

On the other hand, the job's progressive occupation must be carried out in accordance with its characteristics and even the slopes towards its access points.

Eventually, the student must be able to develop a working method for each construction site, learning about the constraints that each one has.

PART II. PROVISIONAL GENERAL CONSTRUCTION SITE FACILITIES

UNIT 3. PROVISIONAL FACILITIES FOR WATER SUPPLY, SANITATION AND EVACUATION ON SITE

UNIT 4. PROVISIONAL FACILITIES FOR ELECTRICITY ON SITE

PART III. AUXILIARY MEANS OF CONTAINMENT: SHORING, INDUSTRIALIZED SHORING SYSTEMS, SCAFFOLDING, ELEMENTS AND MEANS OF CONSOLIDATION

UNIT 5. SHORING AS AN AUXILIARY MEANS. WOODEN SHORING ELEMENTS

UNIT 6. INDUSTRIALIZED SHORING SYSTEMS. SCAFFOLDING

UNIT 7. SCAFFOLDING ACCESSORIES. ELEMENTS AND MEANS OF CONSOLIDATION

PART IV. PRODUCTION AND TRANSMISSION OF ENERGY ON JOBS

L.8. - SOURCES AND ENERGIES

L.9. - COMBUSTION ENGINES

L.10. - ELECTRIC MOTORS AND PUMPS

L.11. - GENERATOR SETS AND PUMPS

7958 Installations III

BLOCK 1: ELECTRICAL INSTALLATIONS

1. INTRODUCTION TO ELECTRICAL SYSTEMS

1.1. Magnitudes and Fundamental concepts.

2. MATERIALS.

2.1. Cables, protection Tubes and protection gutter.
2.2. Protective Boxes.

2.3. Protection Mechanisms.
2.4. Control and protection mechanisms.
2.5. Control mechanisms.

3. DISTRIBUTION NETWORKS

3.1. Aerial networks.
3.2. Underground networks.

4. LOAD FORECAST

4.1. Classification of consumption points.

4.2. Degree of electrification
4.3 Total load corresponding to a building preferably intended for housing.
4.4. Total load corresponding to commercial, office and mixed buildings.

5. SUPPLIES

5.1. Definition.
5.2. Types of supplies.

6. LIAISON FACILITIES

6.1. General protection box
6.2. General power line
6.3. Individual derivation
6.4. Meters: location and installation systems
6.5. General and individual device control and protection board.

7. INSTALLATION OF EARTHING

7.1. Purpose
7.2. Earthing or ground connection. Definition
7.3. Earthing connections.

8. INTERIOR OR RECEPTOR INSTALLATIONS

8.1. General requirements.
8.2. Installation systems.
8.3. Protective tubes and conduits.
8.4. Overcurrent protection.
8.5. Surge protection.
8.6. Protection against direct and indirect contacts.
8.7. Number of circuits and characteristics.
8.8. General installation requirements.
Premises containing a bathtub or shower.

9. INSTALLATION IN PREMISES OF PUBLIC ATTENDENCE

9.1. Scope of application.
9.2. Power for security systems.
9.3. Emergency lighting.

10. INSTALLATIONS IN PREMISES WITH RISK OF FIRE OR EXPLOSION

10.1. Scope of application.
10.2. Site classification.

11. SINGLE-LINE DIAGRAMS

11.1. Learn the standardized electrical symbology of single-line diagrams.
11.2. Graphic representation and Application of electrical symbology in single-line diagrams.

12. RECEPTOR INSTALLATION

12.1. Types of receivers.

BLOCK 2: INTERIOR ILLUMINATION

13.PHOTOMETRY

13.1. Concepts.
13.2. Magnitudes and foundations.

14. LAMPS AND LIGHTS

14.1. Incandescent lamps.
14.2. Discharge lamps.
14.3. Other light sources.
14.4. Lights and their classification.

15. INTERIOR LIGHTING

15.1. Glare.
15.2. Colour.
15.3. Lighting systems.
15.4. Recommended lighting levels.

16. CALCULATION AND DESIGN

16.1. Starting data.
16.2. Number of lights and their location.
16.3. Calculation of installed power.

17.1. General information.
17.2. Characterization and quantification of demand.
17.3. Construction products.
17.4. Maintenance and conservation.

18. DOMOTIC AND AUTOMATION SYSTEMS

18.1. Home automation and its advantages.

BLOCK 3: TELECOMMUNICATIONS

19. COMMON TELECOMMUNICATION INFRASTRUCTURES

19.1. Definition of the network.
19.2. Design Considerations.

20. ENCLOSURES AND CONDUITS.

20.1. Input boxes and link registers.
20.2. Telecommunications facilities enclosures.
20.3. Main, secondary and internal user conduits and their registers.

BLOCK 4: WORKSHOP AND LABORATORY PRACTICES

Electric material.
Cables, tubes and junction boxes.
Elements of Link Installation.
Command mechanisms, control mechanisms and protection.
Lamps and lights.
Measurement switchgear.

7959 Structural steel design

PART I. METAL MATERIALS AND METALLIC STRUCTURES
PART II. REGULATIONS FOR THE DESIGN OF STEEL STRUCTURES
PART III. UNIONS IN METALLIC STRUCTURES
PART IV. TORSION IN METALLIC SECTIONS AND PIECES
PART V. COMPRESSION IN METALLIC PIECES
PART VI. BENDING AND TRACTION IN METALLIC SECTIONS AND PIECES

7960 Project and construction management

UNIT 1. INTRODUCTION

- Introduction to the process of development of a civil work
- Presentation of the entities involved: Designer, Property, Constructor, and Supervisor.
- Fundamental concepts of the content of a project: Report and Annexes, Plans,
- Technical Specifications and Budget

UNIT 2. PROJECT MANAGEMENT

- Introduction: Life Cycle and Project Manager
- Time and Resource Management Cost Management
- Purchasing and HR Management
- Quality Management and Communication

UNIT 3. ORGANIZATION OF WORKS

- Characteristics and functions of the Promoter, Supervision and Site Manager.
- Structure and organization of the construction company
- Planning, organization and monitoring of the development of the work

UNIT 4. CONTRACTS WITH THE PUBLIC SECTOR

- General Provisions.
- The solvency of the contractor: classification of companies
- The price review
- Guarantees required
- Award of contracts
- The execution of contracts

7996 GIS and computer applications in topography and cartography

UNIT 1. CARTOGRAPHY ON THE NET: DOWNLOAD

1.1. Download.
1.2. Management.

UNIT 2. COMPUTER TREATMENT OF TOPOGRAPHIC DATA

2.1. Data dump.
2.2. Data editing.
2.3. Modelling: TIN, DEM, etc.
2.4. Civil engineering: geometric design.
2.5. Lay outs.
2.6. Measurements
2.7. Photorealism.

UNIT 3. METADATA SERVERS

3.1. Concepts.
3.2. Operations.
3.3. Connections.

UNIT 4. GEOGRAPHIC INFORMATION SYSTEMS

4.1. General concepts: Context.
4.2. QGIS: interface, views, tables: edition.
4.3 Datum, prj files.
4.4. Connections to metadata servers.
4.5. Files: shp, dbf, shx, jpgw, asc, geotiff, ecw, dwg, etc.
4.6. Spatial queries.
4.7. Digital Models of the Land.
4.8. Operations with files: geoprocesses with vector files and raster files.
4.9. Maps.
4.10. Application algorithms: QGIS, SAGA, GRASS, etc.
4.11. Application of GIS in civil engineering

7961 Technology of building structures

UNIT 1. CTE DB AE

1 General information.

2 Permanent movement.
2.1 Own weight.
2.2 Prestressing.
2.3 Terrain movement.

3 Variable movement.
3.1 Overload of use.
3.2 Actions on railings and Dividing elements.
3.3 Wind.
3.4 Thermal actions
3.5 Snow.

4 Accidental movement
4,1 Earthquake.
4.2 Fire.
4.3 Impact.

ANNEX A. TERMINOLOGY.

Annex B. Notations and units.

B.1 Notations.

B.3 Units.

ANNEX C. HANDBOOK OF WEIGHT AND INTERNAL FRICTION COEFFICIENTS

Annex D. Wind Action.
D.1 Dynamic pressure.
D.2 Exposure Coefficient.
D.3 External pressure Coefficients.

Annex E. Climatic data.

BASIC PRINCIPLES OF FOUNDATIONS

DIRECT FOUNDATIONS

4 DIRECT FOUNDATIONS.
4.1 Typology.
4.1.1 Insulated footings.
4.1.2. Combined and continuous footings.
4.1.3. Foundation shafts.
4.1.4 Gratings.
4.1.5 Slabs.
4.2 Analysis and dimensioning.
4.2.1 Basic criteria.
4.2.1.1 Concept of sinking.
4.2.1.2 Relative terrain-structure rigidity Forces on foundations elements.
4.2.1.3 Models of interaction. Ballast module.
4.2.2 Verifications.
4.2.2.1 Ultimate limit states.
4.2.2.1.1 Sinking.
4.2.2.1.2 Sliding.
4.2.2.1.3 Overturning.
4.2.2.1.4 Overall Stability.
4.2.2.1.5 Structural Capacity of the foundation.
4.2.2.2 Service limit states.
4.2.2.3 Other additional checks.
4.2.3 Basic variables and terrain parameters.
4.2.3.1 Ultimate limit states.
4.2.3.2 Service limit states.

DESIGN AND CALCULATION OF STRUCTURAL ELEMENTS AND FLOOR STRUCTURES

FLOOR FRAMING

1. PRESENTATION

1.1. Introduction.
1.2. Floors.
1.3. Function of floors.
1.4. Conditioning factors.
1.3. Most common typologies.
1.4. Premises for the choice of slab system.
1.5. History and evolution of slabbed floors.

2. TYPES OF FLOOR SLABS

2.1. Introduction.
2.2. Prefabricated slabs.
2.2.1. Hollow core slabs.
2.2.1.1. Characteristics.
2.2.1.2. Application.
2.2.1.3. On-site placement.
2.2.1.4. Advantages.
2.2.2. Pre-slabs.
2.2.2.1. Characteristics.
2.2.2.2. Application.
2.2.2.3. On-site placement.
2.2.2.4. Advantages.
2.2.3. Metallic slab (collaborating sheet metal).
2.2.3.1. Characteristics.
2.2.3.2. Application.
2.2.3.3. On-site placement.
2.2.3.4. Advantages.
2.3. Implementation on site.
2.3.1. Characteristics.
2.3.2. Application.
2.3.3. On-site placement.

2.3.4. Advantages.

3. COMPARATIVE

3.1. Introduction

Previous considerations: cost and deadline

7962 Technical projects I

UNIT 1. DESIGN CONCEPT OF BUILDING ENGINEERING.

UNIT 2. REGULATIONS ON DESIGN ACTIONS OF BUILDING ENGINEERING.

UNIT 3. DESIGN AND PROJECT METHODOLOGY.

UNIT 4. BUILDING AND RENOVATION PROJECTS.

UNIT 5. PROJECT PHASES.

E.1) Previous studies.
E.2) Preliminary draft.
E.3) Basic project.
E.4) Execution project.

UNIT 6. DETAIL OF THE PHASES OF THE CONSTRUCTION PROJECT.

F.1) Previous studies.
1 Expository record.
2 Sketch.
3 Cost estimates.
F.2) Preliminary draft.
1 Justifying report.
2 Floor Plans, section and elevation.
3 Advance budget.
F.3) Basic project.
1 Justifying report.
2 General Plans to scale of location, site location, urban justification, floor plans, sections and elevations.
3 Estimated budget by chapters.

Note: up to this point it would be strictly the program of the subject Projects I, nevertheless, and taking into account the importance that the basic project has for the later drafting of the

execution project, the following documents that would complete a basic project for obtaining the execution project are included.

F.4) Execution project.

I. Report on the execution project.

1. Descriptive report.
2. Constructive report.
3. CTE compliance.
3.1 Structural safety.
3.1.1 Structural safety.
3.1.2 Actions in Building.
3.1.3 Foundations.
3.1.4 Seismic action.
3.1.5 EHE compliance.
3.1.6 Characteristics of the floor.
3.1.7 Steel structure.
3.2 Fire safety.
3.3 Safety of use.
3.4 Health.
3.4.1 HS1 Protection against moisture.
3.4.2 HS2 Waste collection and disposal.
3.4.3 HS3 Indoor air quality.
3.4.4 HS4 Water supply.
3.4.5 HS5 Waste water disposal.
3.5 Protection against noise.
3.6 Energy saving.
3.6.1 HE1 Energy demand limitation.
3.6.2 HE2 Efficiency of Thermal installations.
3.6.3 HE3 Energy efficiency in lighting installations.
3.6.4 HE4 Minimum solar contribution to DHW production.
3.6.5 HE5 Minimum photovoltaic contribution of electrical energy.
4. Compliance with other regulations.
5. Report appendices.
5.1 Geotechnical information.
5.2 Structure calculation.
5.3 Fire protection.
5.4 Facilities.
5.5 Energy efficiency.
5.6 Quality control plan.
5.7 Health and Safety Study (BASIC).

II. PLANS

• The project will contain as many plans as necessary for the detailed definition of the job.

• In the case of renovation works, the building plans will be included before the intervention.

Those of the basic project with the modifications that are pertinent in accordance with the report or reports issued by the technical experts from the relevant administration/s. Graphic and dimensional description of the entire structural system (foundation, load/bearing structure and horizontal structure). In those relating to the foundation, its relationship with the immediate environment and the whole of the job will also be included.

Plans of facilities. Graphic and dimensional description of the networks of each installation, plants, sections and details.

Plans of constructive definition. Graphic documentation of constructive details.

Graphic reports. Indication of concrete solutions and singular elements: carpentry, locksmith, etc.

OTHER

III. Specification of conditions

IV. Measurements.

V. Budget.

7963 Quantity surveying II

PART I. MEASUREMENTS AND VALUATIONS OF WORK II

UNIT 1. MEASUREMENT AND VALUATION CRITERIA COVERED

UNIT 2. MEASUREMENT AND ASSESSMENT OF FLOORS AND COATINGS

UNIT 3. MEASUREMENT AND ASSESSMENT CRITERIA CARPENTRY

UNIT 4. MEASUREMENT AND EVALUATION CRITERIA FACILITIES

7964 Techniques for workplace accident prevention

THEMATIC UNIT 1

PREVENTION OF OCCUPATIONAL RISKS - SPECIALTIES

- Basic concepts.
- Safety at Work. Main Risks.
- Industrial Hygiene. Main Risks.
- The Physical Burden at Work. Detection and Prevention. Design of Posts.
- Environmental Conditions.
- The Mental Burden. Detection and Prevention. Psychosocial Risks.

- Risk Assessment. Main Methods. WT Fine Method.
- Accident Notification.
- Statistical Analysis of Accidents. Main Indices.

PREVENTION AUDITS

- Legal audits in the field of Occupational Risk Prevention.
- Obligatory Compliance Regulations.
- Technical Guides.
- Prevention Technical Notes.

ACCIDENTALITY IN SPAIN

- Sectors of Activity.
- Other Variables.

7965 Energetic efficiency

PART I. ENERGY EFFICIENCY OF THE THERMAL ENCLOSURE

GENERAL CONCEPTS

- Objectives for energy efficiency in buildings.
- Basic energy concepts.

EFFICIENCY CHARACTERISTICS IN BUILDINGS

- Location.
- Site.
- Orientation.
- Form.

HERMAL ENCLOSURE: ENERGY CONSERVATION

- Coefficient of heat transmission.
- Thermal insulation: insulating materials.
- The thermal inertia of opaque enclosures.
- Carpentry (doors and windows).

WINTER CONDITIONS: EFFICIENT HEAT COLLECTION

- Passive energy utilization systems.
- Energy accumulation and distribution.
- Greenhouse effect.

- Distribution and location of openings.

SUMMER CONDITIONS: COOLING / EFFICIENT VENTILATION

- Overheating.
- Action against overheating.
- Ventilation as a strategy against overheating.
- Direct cooling actions.

ASSESSMENT OF THE ENERGY PERFORMANCE OF A BUILDING

- CE3X reference software. Application example.

ENERGY EFFICIENCY ANALYSIS AND MEASUREMENT EQUIPMENT

- Thermographic analysis.
- Thermal flow analysis.
- Analysis of infiltrations.

PART II. ENERGY EFFICIENCY OF AIR CONDITIONING AND DOMESTIC HOT WATER

HEAT AND COLD GENERATORS

- General information.
- Generator energy efficiency. Standard, low temperature and condensation boilers. Heat pumps. Coefficients of P.O.P. and E.E.R. energy efficiency.
- Power fractionation in heat and cold production plants.

DISTRIBUTION OF HEAT AND COLD

- General information.
- Thermal insulation of pipe and duct networks.
- Minimum thicknesses.
- Sealing of duct networks.
- Equipment for the transport of fluids. Pressure drops in components. Efficiency of electric motors.

REGULATION AND CONTROL

- General information.
- Control of air-conditioning installations in generation and distribution.
- Control of thermo-hygrometric conditions.
- Control of indoor air quality in air-conditioning systems.
- Control of domestic hot water preparation facilities.

CONSUMPTION ACCOUNTING

- General information.
- Breakdown of energy costs in buildings.

ENERGY RECOVERY

- General information.

- Free outside air cooling. Free-cooling.
- Energy recovery from exhaust air.

USE OF RENEWABLE ENERGIES

- General information.
- Solar contribution for the production of A.C.S.
- Solar contribution for the heating of covered swimming pools.
- Limitation on the use of conventional energy.
- Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

GEOTHERMAL ENERGY IN BUILDINGS

- Geothermal deposits.
- Very low temperature geothermal energy.
- Geothermal exchangers.
- Geothermal heat pumps.
- Applications of geothermal energy in buildings.

WATER REUSE IN BUILDINGS.

- General information.
- Waste water reuse.
- Reuse of rainwater.

PART III. ENERGY EFFICIENCY IN LIGHTING INSTALLATIONS

GENERAL INFORMATION

- Light sources.
- Lamps.
- Lighting.
- Level of interior illumination.

PERFORMANCE OF LIGHTING SYSTEMS

- Calculation of the energy efficiency value of installations (VEEI) in each area.
- Control systems.
- Installation maintenance plan.

➢ Fourth year:

7966 Reinforced concrete I

UNIT1. INTRODUCTION TO REINFORCED CONCRETE

Features of reinforced concrete. Strength of steel & concrete. Bond between steel and concrete. Fire resistance. Protection against corrosion.

PART II. MATERIALS

UNIT 2. MATERIALS. CONCRETE PROPERTIES

Concrete components. Properties of fresh concrete. Factors affecting concrete hardening. Hardened concrete strength. Concrete consistency. Concrete identification. Stress-strain diagram. Young's Modulus. Shrinkage. Creep. Steel as reinforcement.

UNIT 3. THEORY OF SAFETY

External load classification. Characterist value of an external load. Definition of Limit State. Methods to guarantee the safety. Load combinations. Safety factors of materials. Spanish standard for loads in buildings (Código Técnico de la Edificación).

PART III. DESIGN OF REINFORCED CONCRETE UNIDIMENSIONAL ELEMENTS

UNIT 4. ANALYSIS OF THE ULTIMATE LIMIT STATES

Equilibrium limit state. Bending and/or axial force limit state. Shear limit state. Punching limit state. Torsion limit state. Instability limit state. Rebars placing.

UNIT 5. Serviceability Limit States

Crack Control limit state. Deflection limit state

PART IV. DURABILITY AND QUALITY CONTROL

UNIT 6. DURABILITY AND QUALITY CONTROL

Introduction to durability theory. Quality control in reinforced concrete.

7967 Road engineering

PART I. BASIC CHARACTERISTICS OF THE ROAD NETWORK

UNIT 1. THE ROAD NETWORK

UNIT 2. ROAD ENGINEERING ACTIVITIES

UNIT 3. ROADWAY ADMINISTRATIONS

UNIT 4. VEHICLES

UNIT 5. THE DRIVER AND THE PEDESTRIAN

PART II. TRAFFIC

UNIT 6. STUDIES OF TRAFFIC INTENSITIES

UNIT 7. SERVICE CAPACITY AND LEVEL

PART III. DELINEATION

UNIT 8. BASIC PARAMETERS: SPEED AND VISIBILITY

UNIT 9. VEHICLE TRAJECTORY, WHEEL-PAVEMENT INTERACTION

UNIT 10. GEOMETRY OF DELINEATION

UNIT 11. PLANT VIEW OF DELINEATION

UNIT 12. ELEVATION VIEW OF DELINEATION

UNIT 13. COORDINATION BETWEEN PLANT AND ELEVATION VIEWS

UNIT 14. GENERATION OF SOLUTIONS AND THEIR OPTIMIZATION / INTEGRATION IN THE ENVIRONMENT

UNIT 15. TRANSVERSAL SECTION

PART IV. COMPLEMENTARY QUESTIONS

UNIT 16. INTERSECTIONS AND LINKS - ACCESS TO THE ROADWAY

7968 Applied hydraulics

UNIT 1. INTRODUCTION TO WATER MANAGEMENT

UNIT 2. WATER WITHDRAWAL STRUCTURES

UNIT 3. DAMS AND RESERVOIRS

UNIT 4. WATER PIPELINES

UNIT 5. HYDROELECTRIC GENERATION

7969 Building

UNIT 1. INTRODUCTION, PROGRAM AND BIBLIOGRAPHY

Presentation, program and evaluation of the subject. Mandatory and recommended bibliography. Related regulations.

UNIT 2. STRUCTURAL SYSTEMS

Introduction. Typology. Traditional and rational solutions. Structures: reinforced concrete, prefabricated, metallic, load-bearing walls Construction, Retraction and Expansion Joints.

UNIT 3. PRESTRESSED CONCRETE AND PREFABRICATION

- **Pre-stressed and post-tensioned concrete:** Concept of prestressed concrete.Previous and final tensions.
- **Prefabrication:** Concept of prefabrication. Advantages and disadvantages of precast. Typology of prefabricated buildings.

UNIT 4. ACTIONS IN BUILDING

Introduction to Eurocode

UNIT 5. FORGED-FLOOR STRUCTURE

Generalities. Typology: Unidirectional, bidirectional, mixed metallic. Technical specifications of a slab: Interpretation

UNIT 6. FOUNDATIONS

Introduction. Permissible terrain tension. Distribution of pressures. Seating.

- **Surface Foundations:** Rigid and Flexible Foundations. Influence of the eccentricity of the actions in the distribution of pressures Predimensioning and calculation of insulated and median shoe Foundation slabs.
- **Deep Foundations**: Prefabricated piles. Hinca and headless. Piles "in situ". Drilling and concreting. Foundation Wells.

UNIT 7. LAND CONTAINMENT STRUCTURES

Ground pushes. Stability. Thrust classes Determination of the thrust.

- **Walls in bracket and basement walls:** Introduction. Essential differences in its execution and structural behavior. Predimensioning Concrete joints, retraction and expansion. Waterproofing
- **Screen walls and pile walls:** Execution of continuous and discontinuous displays Fasteners: Assets and liabilities Emptying the enclosure.

UNIT 8. STRUCTURAL CALCULATIONS BUILDING USING PROG. COMPUTER

Application prog. Calculations of a standard Edification structure.

7970 Technical projects II

A) DESIGN CONCEPT OF BUILDING ENGINEERING.

B) REGULATIONS ON DESIGN ACTIONS OF BUILDING ENGINEERING.

C) DESIGN AND PROJECT METHODOLOGY.

D) BUILDING AND URBANIZATION PROJECTS AND CIVIL JOBS.

E) PHASES OF THE BUILDING PROJECT.

E.1) Previous studies.
E.2) Preliminary draft.
E.3) Basic project.
E.4) Execution project.
F) PHASES OF THE URBANIZATION PROJECT AND CIVIL JOBS.
F.1) Preliminary draft.
F.2) Execution project.
G) DETAIL OF THE PHASES OF THE BUILDING PROJECT.
G.1) Previous studies.

1 Expository record.
2 Sketch.
3 Cost estimate.
G.2) PRELIMINARY DRAFT
1 Justifying report.
2 Floor Plans, elevations and sections.
3 Budget advance.
G.3) BASIC PROJECT
1 Descriptive report.
2 General Plans to scale of Floors, elevations and sections.
3 Budget by chapter, trade or technology.
G.4) EXECUTION PROJECT

I. REPORT ON THE EXECUTION PROJECT

1. Descriptive report.
2. Constructive report.
3. CTE compliance.
3.1 Structural safety.
3.1.1 Structural safety.
3.1.2 Actions in Building.
3.1.3 Foundations.
3.1.4 Seismic action.
3.1.5 EHE compliance.
3.1.6 Characteristics of the floor.
3.1.7 Steel structure.
3.2 Fire safety.
3.3 Safety of use.
3.4 Health.
3.4.1 HS1 Protection against moisture.
3.4.2 HS2 Waste collection and disposal.
3.4.3 HS3 Indoor air quality.
3.4.4 HS4 Water supply.
3.4.5 HS5 Waste water disposal.
3.5 Protection against noise.
3.6 Energy saving.
3.6.1 HE1 Energy demand limitation.
3.6.2 HE2 Efficiency of Thermal installations.
3.6.3 HE3 Energy efficiency in lighting installations.
3.6.4 HE4 Minimum solar contribution to DHW production.
3.6.5 HE5 Minimum photovoltaic contribution of electrical energy.
4. Compliance with other regulations.
5. Report appendices.
5.1 GEOTECHNICAL INFORMATION.

5.2 STRUCTURAL CALCULATION.

5.3 FIRE PROTECTION

5.4 BUILDING INSTALLATIONS.

5.5 ENERGY EFFICIENCY.

5.6 ENVIRONMENTAL IMPACT STUDY.

5.6 QUALITY CONTROL PLAN.

5.8 SAFETY AND HEALTH STUDY OR BASIC STUDY, IF APPLICABLE.

II. PLANS

• The project will contain as many plans as necessary for the detailed definition

of the job.

• In the case of renovation jobs, the building plans will be included before the intervention.

SITUATION PLAN * Refers to current planning, with reference to

localizable points and with indication of the geographic north.

EMPLOYMENT PLAN* Urban justification, alignments, setbacks, etc.

URBANIZATION PLAN*. Road network, connections, etc.

GENERAL FLOORS*. Dimensioned, with an indication of scale and uses, reflecting

fixtures and fittings, where necessary for the purpose of verifying the conformity of the

functionality of spaces

ROOF PLANS*. Slopes, water collection points, etc.

Elevations and sections*. Dimensioned, with indication of scale and height of plants,

forging thicknesses, total heights, to check compliance with urbanistic and functional requirements

STRUCTURE PLANS. Graphic and dimensional description of the entire structural system

In those relating to the foundation, its relationship with the immediate environment and the whole of the job will also be included.

INSTALLATION PLANS. Graphic and dimensional description of the networks of

each installation, floors, sections and details.

Plans of constructive definition. Graphic documentation of constructive details.

Graphic reports. Indication of concrete solutions and singular elements:

carpentry, locksmith, etc.

OTHER

III SPECIFICATION OF CONDITIONS.

- ADMINISTRATIVE CLAUSE SPECIFICATION.
- GENERAL PROVISIONS.
- OPTIONAL PROVISIONS.
- ECONOMIC PROVISIONS.
- SPECIAL TECHNICAL SPECIFICATIONS.
- MATERIAL REQUIREMENTS.

Minimum technical characteristics to be met by products, equipment and systems to be incorporated into the job, as well as its supply conditions, reception and conservation, storage and handling, quality assurance and quality control reception to be carried out, including sampling of the product, tests to be carried out acceptance and rejection criteria, and the actions to be taken and the criteria to be adopted of use, conservation and maintenance.

These specifications can be made by reference to general specifications that are of application, Recognized Documents or others that are valid at the discretion of the designer.

- PRESCRIPTIONS REGARDING EXECUTION BY WORK UNITS.

Technical characteristics of each work unit indicating its execution process, implementing rules, preconditions to be fulfilled before its implementation, permissible tolerances, conditions of termination, conservation and maintenance, performance control, trials and tests, quality assurance, criteria of acceptance and rejection, measurement criteria and evaluation of units, etc.

Measurements will be needed to ensure compatibility between the different products, elements and construction systems.

- PRESCRIPTIONS ON VERIFICATIONS IN THE FINISHED BUILDING.

The verifications and service tests to be carried out shall be indicated to check the final performance of the building.

IV MEASUREMENTS.

Development by headings, grouped in chapters, containing all the technical descriptions necessary for its specification and valuation.

V. BUDGET.

- APPROXIMATE BUDGET*

Approximate valuation, detailed by chapter, of the material execution of the job.

- DETAILED BUDGET.

Price table grouped by chapters.

Summary by chapters, with expression of the final value of execution and contract.

It will include the quality control budget.

Health and Safety Study Budget.

VI. WORK MANAGEMENT.

1 WORK ORDERS, GRAPHICAL AND WRITTEN.

2 WORK CERTIFICATION.

VII. LIQUIDATION AND RECEPTION OF JOB.

1 FINAL FINANCIAL STATEMENT OF JOB.
2 CERTIFICATE OF PROVISIONAL RECEIPT, GUARANTEE AND FINAL RECEIPT.

H) DETAILS OF THE PHASES OF THE URBANISATION PROJECTS AND CIVIL WORKS.
G.1) PRELIMINARY DRAFT.
1 Justifying report.
2 Floor Plans, elevations and sections.
3 Budget advance.

G.2) EXECUTION PROJECT

3 Descriptive record OF THE Specific Urbanization Projects and Civil jobs, containing:
a. General report.
b. Report appendices.
c. Specification of conditions.
d. General Budget Summary.
4 Specific projects, containing:
a. Descriptive report.
b. Report appendices. Characteristics and calculations.

c. Floor Plans, elevations, profiles, sections, etc.
d. Specification of conditions.
e. Budget, with Measurements, price charts. Partial Budgets and General Budget.
5 Works management, graphical and written, with Dimension Plans
6 Final settlement and hand-over of works.
a. Final financial statement of works.
b. Certificate of provisional hand-over, guarantee and final receipt.

I) DEMOLITION PROJECTS. OTHER PROJECTS.

7971 Surveys and valuations

THEMATIC UNIT 1. - PERITATIONS

CHAPTER 1. LEGAL FRAMEWORK

1.1. Rules governing the exercise of professional activities.

CHAPTER 2. INTRODUCTION

2.1. General concepts.
2.2. Conditions to be an expert.

CHAPTER 3. CLASSIFICATION OF THE EXPERT'S REPORT

3.1. Depending on the issuer of the order.
3.2. Depending on jurisdiction.
3.3. Depending on the subject matter of the expertise.

CHAPTER 4. PREPARATION OF THE REPORT

4.1. Previous data. Acceptance of the order.
4.2. Collection of information.
4.3 Investigation of the facts.
4.4. Results.
4.5. Writing the report.
4.6. Importance of language.
4.7. Ethics and deontology.

CHAPTER 5. CONTENTS OF THE REPORT

5.1. Preamble.
5.2. Table of contents.
5.3. Author(s) of the report.
5.4. Background information.
5.5. Purpose of the report.
5.6. Documentation used
5.7. Inspections carried out. Methodology.
5.8. Description of observations, checks, findings.
5.9. Results according to the object of the expertise. Justification of the results.
5.10. Proposals for action. Justification of the proposals.
5.11. Assessment of the repair system. Justification of the method used.
5.12. Conclusions.
5.13. Annexes.

CHAPTER 6. OBLIGATIONS AND RIGHTS OF THE EXPERT

6.1. Liability of experts.
6.2. Appointment of the judicial expert.
6.3. Experts' fees.
6.4. Conditions for experts.
6.5. Disqualifications of the experts.
6.6. Issuance and ratification of the opinion.

7. CHAPTER 7. INTERVENTION OF THE EXPERT IN THE ACT OF THE TRIAL OR HEARING

7.1. False testimony.
7.2. The expert opinion.

THEMATIC UNIT 2. APPRAISALS

8. CHAPTER 8. INTRODUCTION TO THE REAL ESTATE VALUATION

8.1. Definition, concept, variables and types. Application and principles.
8.2. General structure of valuation reports.
8.3. Valuation methods according to their purpose.

9. CHAPTER 9. COST METHOD AND VALUATION METHOD BY COMPARISON

9.1. Gross (crb) and net (crn) replacement value.
9.2. Concept of depreciation.
9.3. The real estate market.

10. CHAPTER 10. RESIDUAL METHOD OF SOIL VALUE

10.1. Basic concepts of financial mathematics. Technique of cash flow, IRR and NPV.
10.2. The market value of the land. Land impact value.
10.3. Static and dynamic residual method.

11. CHAPTER 11. UPDATING METHOD

11.1. Updating of expected income. Capitalization of current income.
11.2. Valuation of buildings linked to economic exploitation.

12. CHAPTER 12. WARRANTY ASSESSMENTS

12.1. The mortgage market.
12.2. Mortgage appraisals. Regulations and legal framework.
12.3. Appraisal procedures.

7972 Pavement design

UNIT 1. ROADWAY FOUNDATIONS

1.1 Roadway infrastructure
1.2 Drainage of roadways

UNIT 2. ROADWAY PAVEMENTS

2.1 Stabilizations
2.2 Aggregates for roadway pavements
2.3 Granular layers for roadway pavements
2.4 Bituminous binders for roadways
2.5 Surface treatments, mortars and cement slurries
2.6 Bituminous mixtures
2.7 Auscultation of pavements
2.8 Sizing and reinforcement of pavements

7973 Sustainable construction

TOPIC 1. SUSTAINABLE CONSTRUCTION INTRODUCTION

1. WHAT IS SUSTAINABILITY?

2. WHY SHOULD WE INTRODUCE THE CONCEPT OF SUSTAINABILITY IN CONSTRUCTION?

3. CURRENT SITUATION.

4. SUSTAINABLE CONSTRUCTION.

4.1. Integration with the environmental characteristics of the environment.

4.2. Not more economically expensive.

4.3 Saves resources.

4.4. Saves energy.

4.5. Waste management.

4.6. Increases user comfort.

5. SUSTAINABLE BUILDINGS.

6. LEGISLATIVE FRAMEWORK.

TOPIC 2. SUSTAINABLE URBANISM

1. BRIEF HISTORICAL NOTE

1.1. The modern city of movement

2. CONSEQUENCES OF URBANIZATION ON THE TERRITORY. THE ECOLOGICAL FOOTPRINT

2.1. Consequences of urbanization for the territory

2.2. The ecological footprint.

3. SUSTAINABLE URBANISM.

3.1. Sustainable urban planning.

TOPIC 3. SUSTAINABLE ARCHITECTURE AND CONSTRUCTION

1. SUSTAINABLE ARCHITECTURE.

1.1. Main building design guidelines.

2. STUDY OF THE BUILDING ENVIRONMENT.

2.1. Orientation. Sun exposure.

2.2. Location.

3. ACTIVE AND PASSIVE SYSTEMS.

4. PASSIVE SYSTEMS FOR WINTER CONDITIONS.

4.1. Solar capture systems.

4.2. Energy accumulation and distribution.

5. PASSIVE SYSTEMS FOR SUMMER CONDITIONS.

5.1. Passive cooling systems.

6. LIFE CYCLE ANALYSIS.

6.1. Introduction.

6.2. LCA. Definition and objectives.

6.3. Regulations.

6.4. Methodology.

7. SUSTAINABLE CONSTRUCTION MATERIALS.

7.1. Types of materials.

8. SUSTAINABLE BUILDING SYSTEMS.

9. REHABILITATION OF EXISTING BUILDINGS.

10. TOOLS FOR ENVIRONMENTAL ASSESSMENT OF BUILDINGS.

TOPIC 4. RENEWABLE ENERGIES IN CONSTRUCTION

1. Use of renewable energies.

- Biomass.
- Hydraulics.
- Wind.
- Solar.
- Geothermal.

7974 Total quality, safety and environmental management

UNIT 1. INTRODUCTION. CONCEPT OF QUALITY; SAFETY AND ENVIRONMENT.

1.1.- Introduction. Concept of Quality; Safety and Environment

UNIT 2. EVOLUTION TO TOTAL QUALITY. PARALLELISM WITH SECURITY.

2.1. - History of Quality.

2.2. - Evolution of the Quality Concept.

2.3. - Evolution of the Company's Organization Charts.

UNIT 3. APPROACHES, PRINCIPLES AND DEFINITIONS OF TOTAL QUALITY MANAGEMENT.

UNIT 4. JUSTIFICATION OR QUALITY OBJECT.

4.1. - Deming Chain Reaction.

UNIT 5. STANDARDIZATION STRUCTURE AND QUALITY SEALS.

5.1. - International and national standardization bodies.

5.2. - Certification and product quality seals, systems and people.

5.3. - ISO 9001. Parallelism with ISO 14000 and ISO 8900.

5.4. - Audits.

UNIT 6. MODELS.

6.1. - Circles.

6.2. - EFQM.

6.3. - “Pillars”.

6.3.1. - G.C.T. and Customer Satisfaction

6.3.2. - G.C.T. and Cost (waste). Costs of Quality and no quality. Analysis of the nonconformities in the construction company.

6.3.3. - G.C.T. and the Human Factor

6.3.4. - G.C.T. and Continuous Improvement (Kaizen)

UNIT 7. QUALITY TOOLS.

7.1. - Preventive tools in development.

- QFD.
- AMFEC.
- SMED.

7.2. - Production control.

- Control charts by attributes.
- Control charts by variables.
- Process capability studies.
- Sampling Plans.

7.3. - Quality management.

- Troubleshooting.
- Quality Costs.
- Quality systems.

7.4. - Basics.

- Brainstorming.
- Data collection.
- 7.5 Why?
- Cause-Effect Diagram.
- Verification and data collection.
- Diagram of evolution or situation.
- Pareto Diagram.

- Frequency distributions. Histograms.
- Scatter diagrams.
- Flow, process, activity, etc. diagrams.
- Tree Diagrams.
- Relationship diagrams.
- Matrix diagrams.
- Reports

UNIT 8. QUALITY IN BUILDING IN THE PROJECT AND ON SITE.

8.1. - The architectural project: minimum contents.

8.2. - Quality Control of the project: EHE and EAE.

8.3. - Supervision of the Project in the Law of Contracts of the Public Sector

8.4. - Work Quality Control Planning: CTE, PAC and PPI.

8.5. - Quality Control in execution phase.

8.6. - On-site reception control.

8.7. - Control by means of tests.

8.8. - Control of the finished work.

8.9. - Quality seals, marks and logos.

8.10. - CE Marking, Construction Products Regulations.

UNIT 9. SAFETY MANAGEMENT: RISK ASSESSMENT IN CONSTRUCTION JOBS.

9.1. - Risk Assessment related to the work positions, type of specific machinery.

9.2. - PRL measures.

9.2. - OSHAS.

7975 Constructions procedures

UNIT 1. INTRODUCTION.

Subject presentation

UNIT 2. FORMWORK AND SHORING

Introduction. Concept of formwork and shoring. Dense shoring. Granty shoring. Movable scaffolding systems. Self-Climbing Hydraulic Formwork. Formwork of vertical elements.

UNIT 3. PRESSTRESSED CONCRETE

Introduction to presstressed concrete. Basic assumptions. Technological solutions. Tensioning process. Tensioning equipment.

UNIT 4. CONCRETE JOINTS

Introduction. Types of joints. Pathologies related to incorrect placement of joints

UNIT 5. TIMBERING, SHEET PILING AND PIPES

Introduction. Temporary timbering of trenches. Timbering: practical solutions. Sheet piling: practical solutions. Application of shoring and sheet piling to the execution of pipes.

UNIT 6. FOUNDATIONS

Introduction. Shallow foundations. Deep foundations. Semi-deep foundations.

UNIT 7. WALLS AND SHEET PILES

Introduction to earth retaining systems. Gravity walls. Block walls. Concrete walls. Reinforced floor walls. Sheet piles. Metal sheet piling

UNIT 8. BRIDGES

Introduction. Structural typologies. Constructive procedures.

UNIT 9. TUNNELS

Introduction. Basic concepts of tunnels. Tunnel construction using traditional methods. Tunnel Boring Machine (TBM). False tunnel.

UNIT 10. COASTAL PROTECTIONS (SEA DYKES)

Introduction. Function of sea dykes. Types of sea dykes. Sloping sea dykes. Vertical sea dykes. Construction procedures for sea dykes.

7976 Procedures and construction machinery

Procedures and Construction Machinery.

TOPIC 1. EARTH MOVEMENTS.

TOPIC 2. TRANSPORTATION AND LAYING CONCRETE.

TOPIC 3. TRANSPORTATION AND APPLICATION OF BITUMINOUS MIXTURES.

TOPIC 4. EXECUTION OF RIGID AND FLEXIBLE PAVEMENTS.

TOPIC 5. EXECUTION OF FOUNDATIONS.

TOPIC 6. MACHINERY FOR THE TREATMENT OF THE SOIL.

TOPIC 7. MACHINERY FOR RAILWAY WORKS.

TOPIC 8. MACHINERY FOR UNDERGROUND WORKS: TUNNELS.

TOPIC 9. AUXILIARY EQUIPMENT FOR CONSTRUCTION

7977 Industrialized construction

UNIT 1. INTRODUCTION, PROGRAM AND BIBLIOGRAPHY

Presentation, program and evaluation of the subject. Mandatory and recommended bibliography. Related regulations.

UNIT 2. PRESTRESSED AND POST-TENSIONING

Presentation, program and evaluation of the subject. Mandatory and recommended bibliography. Related regulations.

UNIT 3. PREFABRICATION. CLASSIFICATION OF PRECAST

Criteria of classification. Prefabricated light, medium and heavy Prefabricated for building, industrial and civil works Advantages and disadvantages of precast.

UNIT 4. MANUFACTURING PROCESS

Manufacturing processes. General Process Characteristics
Manufacturing control.
Anchors for handing

UNIT 5. PREFABRICATION INSTALLATIONS

Generic scheme of an installation. Example of prefabrication plant
Molds and vibrators
Selection of cranes for assembly

UNIT 6. PREFABRICATED CONCRETE IN CIVIL WORKS

Typology and employment
Handling, transportation and assembly
Unions

UNIT 7. PREFABRICATED IN EDIFICATION AND INDUSTRIAL WORKS

Typology and use in building
Typology and employment in industrial works
Handling, transportation and assembly
Unions

- **Fifth year:**

7982 Fundamentals of urbanism and territory

UNIT1. INTRODUCTION. CITY AND URBAN PLANNING

UNIT 2. BASIC CONCEPTS AND TERMINOLOGY

UNIT 3. LEGAL FRAMEWORK

UNIT 4. BASIC URBAN PLANNING PRACTISES

7983 Civil engineering projects

PART I. STRUCTURE OF A PROJECT

UNIT 1. PROJECT DOCUMENTS

PART II. VALUATION OF PROJECTS AND WORKS

UNIT 2. VALUATION OF WORKS

UNIT 3. BREAKDOWN OF UNITARY PRICES

PART III. MEASUREMENT OF WORKS PROJECTS

UNIT 4. PRACTICAL MEASUREMENT ON THE PLANE

7984 Railways and cableway engineering

PART I. RAILWAYS

TOPIC 1: RAILWAY AND RAIL TRANSPORT
TOPIC 2: THE RAILWAY. GENERAL CONSIDERATIONS
TOPIC 3: THE RAIL
TOPIC 4: SLEEPERS
TOPIC 5: FASTENERS
TOPIC 6: BASE LAYERS
TOPIC 7: SUBGRADE
TOPIC 8: JOINTED TRACK
TOPIC 9: LONG WELDED RAIL
TOPIC 10: SWITCHES AND CROSSINGS
TOPIC 11: BALLASTLESS TRACK SYSTEM
TOPIC 12: TRACK GEOMETRY
TOPIC 13: RAIL ELECTRIFICATION SYSTEMS
TOPIC 14: SAFETY AND SIGNALLING SYSTEMS
TOPIC 15: THE TELECOMMUNICATION NETWORKS
TOPIC 16: THE RAILWAY STATIONS

PART II. TRANSPORTE POR CABLE

TOPIC 17: THE CABLEWAYS

7985 Reinforced concrete II

PART I. CONSTRUCTION DRAWINGS OF REBARS

UNIT 1. REBAR SCHEDULES
Rebar schedules for linear elements.

UNIT 2. REINFORCEMENT DETAILING
Reinforcement detailing in linear elements.

PART II. REINFORCEMENT IN FLAT ELEMENTS

UNIT 3. REINFORCEMENT IN FLAT ELEMENTS
Reinforcement in unidimensional sheets. Reinforcement in bidimensional sheets with main efforts parallels to reinforcement directions. Flexible concrete footings. Types of cracks in sheets.

PART III. DESIGN OF STRUCTURAL REGIONS

UNIT 4. DESIGN OF STRUCTURAL REGIONS
Introduction to strut&tie method. Design of the structural regions included in EHE-08. Concentrated loads on solid block elements. Corbels. Deep beams. Ridig footings. Rigid cap piles on two or more piles

7986 Safety concepts in construction processes

UNIT 1. INTRODUCTION

- DEFINITIONS
- LEGAL FRAMEWORK
- PRINCIPLES OF PREVENTIVE ACTION

UNIT 2. HEALTH AND SAFETY ORGANIZATION

- PREVENTIVE SERVICES
- OTHER MAIN ACTORS
- THE PLANNING OF PREVENTIVE ACTIONS (PROJECT PHASE AND CONSTRUCTION PHASE)

UNIT 3. SPECIFICS RISKS, COLLECTIVE PROTECTIVE AND PREVENTIVE MEASURES DURING THE CONSTRUCTION WORKS 1. PRELIMINARY WORKS

- PRELIMINARY WORKS
- TRENCHING AND DIGGING
- CONCRETING WORKS
- FALLING PROTECTION
- CONSTRUCTION MACHINERY AND OTHERS

7987 Design of water and wastewater systems

UNIT 1. WATER SUPPLY – TREATMENT SYSTEM
UNIT 2. WATER SUPPLYPIPING NETWORKS
UNIT 3. SEWERAGE NETWORKS
UNIT 4. CLEANSING OF RESIDUAL WATERS

7988 Coastal engineering and constructions

PART I. COAST DYNAMIC

UNIT 1. COASTAL WAVES AND WAVE TRANSFORMATION
UNIT 2. WAVE PREDICTION
UNIT 3. DYNAMICS OF OCEANIC WATER MASSES

PART II. MARITIME STRUCTURES

UNIT 3. CLASSIFICATIONS OF MARITIME STRUCTURES
UNIT 4. RUBBLE-MOUND SLOPES
UNIT 5. VERTICAL BREAKWATERS

PART III. COAST ENGINEERING

7989 Pathology and rehabilitation

BLOCK 1. PATHOLOGY AND REHABILITATION

CHAPTER 1 INTRODUCTION AND TYPES OF INJURIES

- Safety threshold.
- Pathological process.
- Injury-cause.
- Classification of injuries.
- Physical injuries.
- Mechanical injuries.
- Chemical injuries.
- Direct and indirect causes.

CHAPTER 2 GENERAL METHODOLOGY, INSPECTIONS, INSTRUMENTATION

- Pre-diagnosis.
- Previous studies/diagnosis.
- Final report, final diagnosis/conclusion.
- Classifications of inspections.
- Data collection.
- Fieldwork.
- Inspections of seats, shifts and instrumentation.
- Inspection of structural movements.
- Instrumentation.
- Humidity Inspections.
- Other inspections.

CHAPTER 3 COMPATIBILITY OF MATERIALS

- Introduction.
- Compatibility Types.
- Physical Compatibility.
- Chemical Compatibility.

CHAPTER 4 PATHOLOGY OF FOUNDATIONS

- Causes of foundation-related problems.
- Symptomatology of foundation failures.
- Footing.
- Cracks and fissures.

- Incidence of footings on structural buildings.
- Framework.
- Incidence of footings on structural buildings.
- Resistant Wall strength.
- Foundation reinforcements.
- Building rehabilitation.

CHAPTER 5 PATHOLOGIES OF BUILDINGS BASED ON THE STRUCTURE OF

- Resistant Walls.
- General concepts.
- Pathology of adobe and rammed earth resistance walls.
- Physical Injuries Mechanical Injuries and Chemical Injuries.
- Pathology of buildings based on the structure of stone walls.
- Physical, chemical and mechanical injuries.
- Wall-based building rehabilitation.

CHAPTER 6 PATHOLOGY OF CONCRETE

- Introduction.
- Damage of hydrothermal origin.
- Damage due to the action of burdens.
- Damage due to girder and pillar lattice structures.
- Damage to wall-based structures.
- Damage to slabs.
- Damage to slab-based forgings and/or slabs.
- Lightened and / or masses.
- Damage to one-way slabs in situ.
- Damage to prefabricated slabs.
- Fire Damage.
- Chemical Damage in concrete.
- Damage caused by carbonation (co2).
- Damage caused by sulphate attack.
- Damage caused by corrosion of the reinforcement meshes.
- Concrete reinforcements.

CHAPTER 7 PATHOLOGIES IN METAL STRUCTURES

- Definitions and typologies.
- Pathologies due to the project phase.
- Pathologies due to the manufacturing phase.
- Pathologies due to the assembly phase.
- Pathologies attributable to the service phase.
- Rehabilitation systems and structural reinforcement.

CHAPTER 8 PATHOLOGY OF WOODEN STRUCTURES

- Definition and typologies.
- Degradation of wood.
- Abiotic degradation.
- Biotic degradation.
- Protection of wood.
- Reinforcement of wooden structures.
- Traditional reinforcements.
- Wood-based reinforcements.
- Metal reinforcements.
- Modern reinforcements.
- Beta system.
- Carbon fibre-based system.

CHAPTER 9 FACADE PATHOLOGY

- Humidity in facades.
- Pathology of enclosures based on exposed bricks.
- Pathology of enclosure based on elemental finishes.
- Pathology of veneers.
- Pathology of cladding.
- Pathology of finishes with wall tiles.
- Pathology of facades based on prefabricated elements.
- Oxidation and corrosion of metal facade elements.
- Pathology of facades based on decorations and rendering.
- Rehabilitation of facades.

CHAPTER 10 ROOF PATHOLOGY

- Pathology of flat roofs.
- Pathologies of sloped roofs.

CHAPTER 11 TECHNICAL INSPECTIONS OF BUILDINGS

PHOTOGRAMMETRY

7990 Environmental engineering

UNIT 1. REGULATORY FRAMEWORK

UNIT 2. STUDY OF ENVIRONMENT AND ENVIRONMENTAL INVENTORY

UNIT 3. IDENTIFICATION OF ACTIONS AND IMPACTS

7991 Bridge and singular structure construction

PART I. INTRODUCTION TO THE DESIGN OF SINGULAR STRUCTURES

UNIT 1. INTRODUCTION TO THE DESIGN OF SINGULAR STRUCTURES

Introduction to design. Bridges' history. Scale and proportions.

PART II. MATERIALS

UNIT 2. MATERIALS

Properties of materials. Advantages and disadvantages.

PART III. BEAM BRIDGES

UNIT 3. BEAM BRIDGES

Precast beams bridges. Concrete slab deck bridges. Box girder deck bridges. Singular construction procedures.

PART IV. ARCH BRIDGES

UNIT 4. ARCH BRIDGES

Arch bridges with upper deck. Arch briges with lower deck. Arch bridges with intermediate deck.

PART V. CABLE-STAYED BRIDGES

UNIT 5. CABLE-STAYED BRIDGES

Three-span cable-stayed bridges. Asymmetrical two-span cable-stayed briges. Multispan cable-stayed brigdes.

7992 Fundamentals of urban services

UNIT 1. INTRODUCTION TO URBAN SERVICES
UNIT 2. URBAN NEEDS
UNIT 3. TYPES AND CLASSES OF URBAN SERVICES
UNIT 4. COORDINATION OF URBAN SERVICES

7993 Geotechnical engineering

UNIT 1. LATERAL EARTH PRESSURE

1. Lateral earth pressure models
2. Wall analysis and design

3. Cantilever sheet pile walls and timberlng

UNIT 2. SLOPE STABILITY

1. Potentially unstable soil masses
2. Slope stability for soil masses
3. Global stability slope failure
4. Corrective and remedial measures

7994 Final degree project (degree in civil engineering)

7995 Final degree project (degree in technical architecture)