

National University of Engineering (UNI)
Faculty of Civil Engineering
School of Civil Engineering



Book of short descriptions by course

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1.1 MA100. Basic Mathematics

The Basic Mathematics course is mandatory and provides the conceptual tools necessary for logical reasoning and problem solving. The course ranges from propositional logic and set theory to the study of real numbers, complex numbers, polynomials, and matrices. These concepts are fundamental for developing the abstraction and mathematical formalization skills required in the later stages of the Computer Science program.

1.2 MA111. Calculus I

This course introduces the fundamental concepts of differential calculus of single-variable real functions. It provides the mathematical foundations necessary for analyzing change and motion in science and engineering, developing logical reasoning through the study of limits, continuity, and derivatives.

1.3 BCH101. Chemistry I

Chemistry provides the foundation for understanding the composition, structure, and properties of matter – knowledge required across computing, and engineering programs alike as part of a rigorous grounding in the natural sciences. This course introduces the basic principles of general chemistry and extends them to chemical equilibrium and electrochemistry, together with the applied chemistry of water, polymers, and cement, topics that recur in materials science, environmental analysis, and engineering practice.

1.4 BME101. Learning Methodology Workshop

Success in demanding science, engineering, and computing programs depends not only on technical knowledge but also on how effectively students plan their academic and personal life, study, and learn. This workshop equips incoming students in science, engineering, and computing programs with practical learning-methodology tools: life and career planning, evidence-based study techniques, an introduction to how modern AI/ML tools can support their own learning process, the fundamentals of scientific knowledge and applied research, emotional intelligence for personal and interpersonal effectiveness, and the technical communication and teamwork/leadership skills needed to collaborate throughout their studies and professional careers.

1.5 BRC101. Writing and Communication

Effective written, oral, and digital communication is a core engineering competency, independent of any particular specialty. This course develops academic and technical writing, oral presentation, and professional digital-communication skills, so that students can produce clear reports and collaborative academic work, apply standard citation norms, and communicate technical content to varied audiences throughout their engineering studies and professional careers.

1.6 BIC101. Introduction to Programming

This is the first course in the sequence of introductory courses to Computer Science. This course introduces participants to the fundamental concepts of programming using Python. Topics include data types, control structures, functions, lists, recursion, and the mechanics of execution, testing, and debugging. Programming is one of the pillars of Computer Science; any professional in the area will need to program to materialize their models and proposals.

1.7 BMA102. Differential Calculus

Differential calculus is a fundamental mathematical tool shared by computer science and engineering disciplines, providing the foundations for the rigorous study of change, the analysis of rates of change, the optimization of systems and functions, and the modeling of continuous phenomena. This course provides a solid foundation in the concepts and techniques of differential calculus of one variable, with emphasis on its application in scientific and engineering contexts.

1.8 BEC101. General Economics

General Economics introduces the fundamentals of economic theory and its historical evolution, market functioning (supply, demand, and elasticity), market structures, production, costs, and firm profits, business economic and financial management, and the basic aspects of macroeconomics, growth, and globalization, as a foundation for the economic decision-making of engineering and computing professionals.

2.1 CE1G1. General Geology

The General Geology course provides the future civil engineer with the descriptive and analytical foundations of Earth Sciences: the minerals and rocks that constitute geological materials, the structures that record the deformation of the Earth's crust, surface weathering and erosion processes, geological time and the reading of geological maps, and an introduction to applied geology for site characterization. This knowledge constitutes the indispensable conceptual foundation upon which subsequent courses in Soil Mechanics and Geotechnical Engineering are built.

2.2 CS100. Introduction to Computer Science

This course serves as the foundation for understanding the fundamental concepts of computational thinking applicable across various professions.

The course provides, starting from ground zero, a panoramic view of: introductory computational thinking, data storage, computer architecture, operating systems, networks and the Internet, algorithms, sorting methods, software engineering, databases, data structures, software engineering, computer graphics, artificial intelligence among others.

Designed as an introductory course to Computer Science, the concepts are presented in a playful manner and using an Active Learning methodology. Throughout the course, active audience participation is encouraged, akin to a theatrical performance.

The related knowledge areas covered are directly aligned with the Computing Curricula ACM/IEEE-CS.

The course **does not require** any prior knowledge in computer handling topics and can be taken by student from any field.

2.3 AI161. Applied AI

This course provides a practical introduction to Artificial Intelligence (AI) for students from all scientific and engineering disciplines. Focused on developing AI literacy and practical skills, it covers fundamental concepts, modern AI tools (including Western and Chinese platforms), and responsible usage. Students will learn to effectively interact with diverse AI systems, write quality prompts, and apply AI solutions to problems across various domains while understanding ethical implications and cultural contexts of AI deployment.

2.4 CB1E1. Technical Drawing & CAD

Technical Drawing and CAD is a foundational course for engineering students, as it provides the graphical language needed to communicate technical projects. Mastery of descriptive geometry, drafting standards, and Computer-Aided Design (CAD) tools allows students to represent three-dimensional objects with technical precision on a two-dimensional plane, an essential skill for the design, execution, and supervision of engineering projects. The course closes with an application to civil engineering drawings, covering the symbols and conventions used in foundation and basic structural plans.

2.5 MA112. Calculus II

This course covers integral calculus for functions of a single variable and the geometric foundations needed for multivariable calculus. It emphasizes the accumulation of quantities and the inverse relationship between differentiation and integration, provides tools for calculating areas, volumes, arc length, and work, and introduces vectors and the geometry of three-dimensional space, quadric surfaces, parametric equations, polar coordinates, and vector-valued functions of a real variable.

2.6 BFI101. General Physics

Physics I introduces the foundations of classical mechanics as a mathematical and experimental discipline. Through the study of kinematics, Newtonian dynamics, conservation principles, rotational motion, elasticity, fluid mechanics, vibrations and waves, and an introduction to transport phenomena, students acquire the analytical tools needed to model and solve problems of the physical

world. This course provides the indispensable foundation for the study of oscillatory, wave, and electromagnetic phenomena addressed in subsequent courses.

2.7 ID101. Technical and professional English I

English is the primary language of science, engineering, and technology worldwide. For computing and engineering students, mastering English means gaining direct access to technical documentation, research papers, and professional collaboration without translation barriers. This course builds foundational English skills using contexts drawn from computing systems, hardware, and the everyday work of engineers and scientists.

2.8 BEF201. Ethics and Political Philosophy

This course introduces students to the fundamentals of ethics and political philosophy as a humanistic foundation for professional practice, and extends them to engineering ethics and professional responsibility. Through the study of normative ethical theories, the major traditions of political thought, and contemporary debates in political philosophy, students develop the critical tools to analyze moral and political problems. The course closes with the application of these tools to the ethical dilemmas engineers face in professional practice.

3.1 CB1E2. Engineering Drawing II

Engineering Drawing II is the direct continuation of Technical Drawing and CAD, deepening students' command of descriptive geometry to solve advanced positional and metric problems involving lines, planes, polyhedra, and surfaces of revolution. The course closes with an introduction to Building Information Modeling (BIM), the digital methodology that has become standard practice for the delivery and lifecycle management of civil engineering projects, connecting the graphical foundations built in the prerequisite course to modern digital project delivery workflows.

3.2 MA121. Linear Algebra I

This course introduces the fundamental concepts of linear algebra, providing the mathematical foundations for the study of vector spaces, linear transformations, and systems of linear equations. It develops abstract thinking and problem-solving skills through matrices, determinants, and vectors. The course is fundamental for applications in science, engineering, and computing.

3.3 MA210. Calculus III

This course continues the study of calculus with functions of several variables, integrating concepts of vector calculus, partial derivatives, multiple integrals, and geometric and physical applications, including line and surface integrals. It develops skills for modeling and solving problems in three dimensions and

introduces first-order ordinary differential equations, providing the foundations for advanced areas such as mathematical analysis, physics, and engineering.

3.4 BFI102. Physics II

Physics II consolidates the foundations of advanced classical mechanics and electromagnetism. The theory of small oscillations and coupled oscillators provides the analytical framework for the study of vibrational systems in engineering and the sciences. Continuum mechanics supplies the essential tools for the analysis of elastic solids and fluids. The study of electromagnetism, from electrostatics to electromagnetic induction, is fundamental in technology, scientific instrumentation, and geophysical exploration.

3.5 ID102. Technical and professional English II

Building on foundational English skills, this course develops the student's ability to communicate in technical and scientific contexts with greater fluency. Grammar structures are practiced through reading and producing descriptions of technological systems, scientific phenomena, and engineering processes. Students gain vocabulary relevant to computing, data, and the physical sciences.

3.6 CE1M1. Statics

Statics is the first pillar of applied mechanics in Civil Engineering. It provides the tools needed to analyze the equilibrium of particles and rigid bodies subjected to force systems. Understanding the concepts of force, moment, and equilibrium is essential for the analysis and design of structures, enabling the determination of support reactions and internal forces in structural members.

4.1 MA202. Numerical Methods

Numerical methods are a fundamental tool shared by computer science and engineering disciplines for approximating solutions to mathematical problems that cannot be solved analytically. This course provides an introduction to the most common numerical methods, including error analysis, solution of nonlinear equations, interpolation, numerical integration, and solution of differential equations, in scientific and engineering contexts.

4.2 MA211. Calculus IV

This course covers ordinary differential equations, an introduction to partial differential equations, and asymptotic and perturbation methods, extending the multivariable calculus foundations built in previous courses. It develops the analytical tools needed to model and solve differential equations arising in physics and engineering, and to approximate the solutions of problems that cannot be solved in closed form.

4.3 STA251. Statistics and Probability

Probability and statistics provide the mathematical foundation for reasoning under uncertainty, analyzing data, and building predictive models – skills that are essential across computing, artificial intelligence, computational mathematics, and engineering alike. This course develops a rigorous understanding of probability theory and its use in describing random phenomena, together with the fundamentals of descriptive statistics, statistical inference (estimation, hypothesis testing, and Bayesian reasoning), and regression modeling, so that students can summarize and analyze data, quantify uncertainty, and draw sound quantitative conclusions in their own field of application.

4.4 ID201. Technical and professional English III

At this level, students engage with English as the primary medium for accessing and producing technical content in computing, engineering, and the sciences. Grammar structures are applied to reading scientific articles, writing technical reports, describing engineering processes, and participating in professional discussions. The course bridges everyday English fluency with the demands of technical communication.

4.5 CE1M2. Dynamics

Dynamics studies the accelerated motion of particles and rigid bodies under the action of forces. In Civil Engineering, this knowledge is essential for the analysis of structures subjected to time-varying loads, such as earthquakes, wind, vehicular traffic, and heavy machinery. It provides the foundation for advanced courses such as Earthquake Engineering and Structural Dynamic Analysis.

4.6 CE2M1. Mechanics of Materials I

Mechanics of Materials I studies the behavior of deformable solid bodies subjected to different types of loading. For the civil engineer, understanding concepts such as stress, strain, and elasticity is fundamental, since these allow the strength and stiffness of structural elements to be predicted. This knowledge is the basis for the safe design of beams, columns, and shafts, ensuring that materials operate within their allowable limits.

4.7 CE3M1. Concrete Technology

Concrete is the most widely used construction material in civil engineering worldwide. This course provides students with the knowledge required to understand the nature of its components (cement, aggregates, water, and admixtures), the design of mixtures using various methods, and the techniques of placement, consolidation, and curing. Understanding concrete technology is vital to ensure the durability, strength, and safety of infrastructure structures throughout their service life.

5.1 ID202. Technical and professional English IV

At the intermediate level, students apply English to the full range of technical communication required in computing and engineering practice: reading research papers, writing structured technical documents, analyzing case studies, and engaging in professional dialogue. Grammar structures are taught through authentic computing and engineering contexts, reinforcing both linguistic competence and disciplinary knowledge.

5.2 CE2M2. Mechanics of Materials II

Mechanics of Materials II is the advanced continuation of the study of deformable solids. This course addresses problems of greater technical complexity, such as beam deflection using various methods, the elastic stability of columns, and combined-stress failure analysis. These concepts enable students to carry out more refined structural designs and understand the limits of failure by instability, ensuring the integrity of buildings and civil engineering structures.

6.1 MA212. Ordinary Differential Equations

The Ordinary Differential Equations course provides the mathematical tools to analyze systems that evolve with respect to a single independent variable. It focuses on the modeling of dynamic systems through first-order equations, higher-order equations, and systems of equations, using both analytical and numerical methods. It is fundamental for the understanding of mechanics, electrical circuits, and population models.

6.2 ID203. Technical and professional English V

A fundamental part of the integral formation of a professional is the ability to communicate in a foreign language in addition to the native language itself. In the engineering and computing career, technical English is the most critical tool for accessing the forefront of knowledge and research, writing scientific papers, participating in international conferences, and collaborating in global teams. This course brings students to the level of autonomous technical communicators capable of producing and critically evaluating academic and professional content.

7.1 CE2C1. Materials Technology

Materials Technology covers the science and technology of the main materials used in construction: traditional and vernacular materials (rocks, adobe, quincha, rammed earth, bamboo), concrete and advanced cementitious materials, structural metals, polymeric and sustainable composite materials, and standardized quality control and failure analysis testing. The course concludes with design in masonry, timber, and light-gauge steel.

7.2 CE2C2. Construction Technology I

Construction Technology I covers construction methods, equipment, and productivity, including earthmoving and construction processes for concrete and steel structures. The course also includes safety and risk management on construction sites, and an introduction to digital construction technologies (BIM) for project management.

7.3 CE2C6. Territorial Planning I

Territorial Planning I introduces the historical process of human settlement and territorial planning, planning theories and methodologies, and the different types and modalities of urban and territorial planning through case studies.

7.4 CE2C8. Business Management in Construction I

Business Management in Construction I applies the fundamentals of business administration – contract law, project finance, cost accounting, entrepreneurship, marketing, labor regulation, and managerial decision-making – to the specific problem of running a construction company. Building on the introductory organizational and operational concepts covered in Organization and Business Management, this course equips the future civil engineer to negotiate and manage construction contracts, evaluate the financial viability of projects and control their costs, structure and market a construction business, comply with labor regulation, and make sound managerial decisions under the risk and uncertainty typical of the construction sector.

7.5 CE2G1. Soil Mechanics I

Soil Mechanics I introduces the future civil engineer to soil as an engineering material, building on the descriptive foundations established in General Geology. The course develops the phase-relationship framework used to describe the state of a soil, the classification systems (USCS and AASHTO) used to communicate its expected engineering behavior, the theory and field control of compaction as the primary tool for improving earthwork properties, and the hydraulic behavior of soils — permeability, seepage, capillarity, and effective stress — that governs the interaction between water and the soil skeleton in geotechnical design. The course closes with an introduction to subsurface exploration and sampling methods, providing the field basis on which the laboratory characterization covered earlier in the course, and the subsequent Geotechnical Engineering sequence (Soil Mechanics II, Foundations, Earth Retaining Structures), are built.

7.6 CE2H1. Fluid Mechanics I

Fluid Mechanics I is the introductory course in the Hydraulics area that lays the physical and mathematical foundations — mechanics of materials, analytical mechanics, and thermodynamics — necessary to analyze the behavior of fluids at

rest and in motion. The course culminates with the formulation of the continuity and Navier-Stokes equations, the resolution of pressurized pipe flow, and the preliminary design of hydraulic structures, preparing students for subsequent courses in the Hydraulics line.

7.7 CE2S1. Structural Analysis I

Structural Analysis I addresses the behavior of statically indeterminate structural systems, building on the mechanics-of-materials foundation of determinate analysis. Students learn the classical energy principles (virtual work, Castigliano's theorems, and the Betti-Maxwell reciprocal theorems) that underlie the force method, apply the force method itself to beams, frames, and arches, and are introduced to displacement-based matrix formulations (slope-deflection, moment distribution, and the direct stiffness method) that make computer-based structural analysis possible. This course provides the analytical foundation required for the subsequent design of reinforced concrete, steel, and masonry structural elements.

7.8 CE2S2. Reinforced Concrete Design I

Reinforced Concrete Design I introduces the principles and methodology for the design of reinforced concrete members following limit state design philosophy and the ACI 318 building code. Building on the mechanics of materials, students learn to design beams for flexure and shear, columns for combined axial load and biaxial bending, one-way slabs, and to verify deflection and serviceability requirements. The course also covers the design of supported and cantilevered concrete staircases and an introduction to shallow foundation design, providing the structural design foundation required for subsequent reinforced concrete and earthquake-resistant design courses.

7.9 CE2S3. Steel Design

Steel Design covers the fundamentals and application of the limit states design method (LRFD/ASD) to structural steel members and connections. The course addresses structural steel grades, design criteria and load combinations, the design of tension and compression members, compact and non-compact beams and plate girders, beam-columns under combined flexure-compression/tension, bolted and welded connections, and composite members in compression and in flexure. It provides the design competencies required for steel-framed buildings and industrial structures.

8.1 CE2C3. Concrete Technology I

Concrete Technology I deepens the science of construction materials and concrete technology: advanced cementitious materials, special concretes and concrete in extreme climates, transportation and placement, and statistical quality

control. The course also includes polymeric and sustainable composite materials, and concludes with rehabilitation, strengthening, and structural retrofitting.

8.2 CE2C5. Construction Project Management I

Construction Project Management I covers the planning, scheduling, and management of construction works, including the use of Critical Path Method (CPM) and 4D/5D modeling tools for project control, construction cost estimating and financial management, and the day-to-day management of construction site execution.

8.3 CE2C7. Business Organization and Management

Business Organization and Management introduces the fundamentals of business administration: business types and structure, management and leadership, organization and organizational behavior, logistics, accounting, production, and marketing, as a foundation for the management of construction companies.

8.4 CE2G2. Soil Mechanics II

Soil Mechanics II builds directly on Soil Mechanics I, extending the phase-relationship and hydraulic-behavior framework already developed there into the stress-deformation and strength behavior that governs how soils respond to load. The course first develops shear strength theory and laboratory test interpretation, one-dimensional consolidation and settlement prediction, and stress distribution beneath loaded areas, and then applies this behavioral framework to four major geotechnical design problems: lateral earth pressure and earth-retaining structures, slope stability and landslide mitigation, shallow foundation design, and deep foundation design (piles and drilled shafts). As the second, broad-survey course of the Geotechnical Engineering track, each design topic is introduced at a level appropriate for a first exposure; students who continue into the track's specialization electives will revisit these same topics at a substantially deeper level.

8.5 CE3C2. Construction Technology II

Construction Technology II deepens the construction processes of structural elements: layout and staking of works, formwork and shoring systems, soil mechanics applied to foundations, shallow and deep foundations, structural and non-structural masonry, and rebar detailing and placement of reinforcing steel.

8.6 CE3C5. Construction Project Management II

Construction Project Management II deepens the economic management and control of construction works: analysis of bid documents, quantity takeoffs by specialty, unit cost analysis, direct and indirect costs, budgeting, bidding, and cost control, together with the mechanisms used to adjust contract prices for

cost escalation and to certify and pay work actually performed: polynomial price-adjustment formulas and monthly progress valuations.

8.7 CE3H1. Fluid Mechanics II

Fluid Mechanics II deepens the hydraulic analysis and design initiated in Fluid Mechanics I, covering three major blocks: pressurized pipe flow and pumping systems (including networks, transients, and modeling with specialized software), open channel flow (uniform flow, specific energy, rapidly and gradually varied flow, and modeling with HEC-RAS), and the design of hydraulic control structures (weirs, gates, inverted siphons, and culverts). The course combines classical analytical development with the use of hydraulic modeling tools (WaterCAD, HEC-RAS) employed in professional practice.

8.8 CE3S1. Structural Analysis II

Structural Analysis II extends the matrix methods introduced in Structural Analysis I to the practical, computer-based analysis of building structural systems. Students deepen their command of the direct stiffness method through its application to plane trusses and frames, incorporate seismic loading through dynamic and response-spectrum analysis, and apply these tools in team seminars to the analysis of real building case studies. The course concludes with an introduction to the finite element method and to material and geometric non-linear analysis, providing the computational foundation required for advanced structural design and specialized graduate study.

8.9 CE3S5. Bridges and Structures

Bridges and Structures introduces the fundamentals of bridge engineering, from conceptual planning and typology selection to the structural analysis and design of highway bridge superstructures and substructures according to the AASHTO LRFD Bridge Design Specifications. Building on structural analysis and reinforced concrete design, students learn the basic site and design studies required for a bridge project, the loads and load combinations that govern bridge design, approximate and refined methods for analyzing slab-and-girder superstructures, and the flexural and shear design of reinforced concrete, prestressed concrete, steel composite, and truss superstructure members. The course also covers the design of bridge bearings, abutments, and foundations, and closes with an introduction to road and bridge asset management, providing the design foundation required for professional practice in bridge engineering.

8.10 CE3S9. Prestressed Concrete

Prestressed Concrete introduces the fundamental principles, elastic analysis, and design methodology for prestressed and post-tensioned concrete members following the ACI 318 building code, building directly on the limit state design

foundation established in Reinforced Concrete Design I. Students learn to analyze elastic stresses in prestressed concrete sections under service loads, evaluate composite construction combining precast members and cast-in-place concrete, and calculate immediate and time-dependent losses of prestress. The course develops the design of pretensioned and post-tensioned members for flexural, shear, and torsional strength at the ultimate limit state, the design of post-tensioned slabs including tendon layout, the analysis of statically indeterminate prestressed concrete structures, and the verification of deflection and serviceability requirements, preparing students for advanced structural design practice involving prestressed concrete elements.

8.11 BMI201. Methodology of Engineering Research

Research Methodology in Engineering introduces students to the systematic process of formulating, conducting, and communicating engineering research. The course covers the foundations of the scientific and engineering research process – problem formulation, literature review, research design, data collection and analysis, and academic writing and citation norms – and then applies them directly: each student develops an original research or applied-engineering proposal under individualized faculty advising, presenting and defending it through continuous and final evaluation.

9.1 CE3C15. Professional Competencies Workshop

Professional Skills Workshop is an integrative course that applies, to a real construction project, feasibility, environmental, and social studies, material selection, procurement and contract management, process standardization and quality management, safety and environmental management, planning, simulation of construction processes with BIM tools, and cost, risk, and opportunity control through an integrated management dashboard.

9.2 CE3C9. Integrated Construction Management

Integrated Construction Management covers quality management systems (ISO 9001), environmental management (ISO 14001), and occupational health and safety (ISO 45001) on construction sites, as well as their integration and joint auditing. The course includes on-site environmental management, sustainability and impact mitigation, occupational health and safety according to Peruvian regulations, and concludes with project optimization and project closure.

9.3 CE3G3. Applied Geology

Applied Geology extends the descriptive foundations of General Geology, and draws on the field investigation skills introduced in the Geotechnical Engineering sequence, into the practicing engineering geologist's toolkit for civil infrastructure. The course develops rock mass characterization and standard classification systems, engineering geological and geotechnical mapping, and the geological

evaluation of soils and rocks as natural resources for construction materials, then applies this framework to the siting and design of two major groups of infrastructure works — roads and canals, and bridges, tunnels, and dams — and closes with the classification, field recognition, and hazard mapping of mass movements and other geological hazards relevant to civil works. As part of the Geotechnical specialization track, it complements the design-oriented Soil Mechanics sequence (Soil Mechanics I-II) with the geological judgment required to characterize sites, select construction materials, choose infrastructure alignments, and anticipate geological hazards.

9.4 CE3G4. Soil Mechanics Applied to Transportation Roads

Soil Mechanics Applied to Transportation Roads is the pavement-engineering course of the Geotechnical Engineering track, building on the subgrade behavior established in Soil Mechanics II to address the design, evaluation, and management of the pavement structure itself. The course first develops the design philosophy of pavements and the mechanisms by which flexible and rigid pavements fail, then covers the traffic, subgrade, and material parameters that govern pavement design, the structural design of flexible and rigid pavements using empirical and mechanistic-empirical methods, and the criteria used to decide when and how to rehabilitate an existing pavement. The course closes with the surface and structural evaluation techniques (distress surveys, roughness, and deflection testing) used to diagnose the condition of an in-service pavement, and the maintenance and rehabilitation planning that follows from that diagnosis.

9.5 CE3G5. Finite Elements Applied to Geotechnical Engineering

Finite Elements Applied to Geotechnical Engineering introduces the finite element method as a numerical tool for the analysis and design of geotechnical structures and problems that cannot be solved reliably with classical closed-form methods. Building on the shear-strength, consolidation, and design framework developed in Soil Mechanics II and the numerical modeling background introduced in Fluid Mechanics II, the course first develops the mathematical foundations of the finite element method (variational formulation, Galerkin approximation, finite element spaces, and error estimation) and then applies them to geotechnical-specific problems: boundary conditions, initial stress states, and staged-construction modeling; one-dimensional analysis of consolidation and pile-soil interaction; two-dimensional plane-strain analysis of excavations, embankments, and retaining structures; an introduction to dynamic numerical analysis of seismic geotechnical problems; and the constitutive soil models (Mohr-Coulomb, Cam-Clay, and Hardening Soil Model) that make nonlinear soil behavior tractable in finite element software. As part of the Geotechnical Engineering specialization track, the course prepares students to use modern numerical modeling tools in professional geotechnical design practice.

9.6 CE3G6. Earth Dams

Earth Dams is a Geotechnical Engineering track specialization elective that applies the shear strength, seepage, and slope stability framework developed in Soil Mechanics II, together with the open-channel and hydraulic-structures framework developed in Fluid Mechanics II, to the analysis, design, construction, and operational safety of embankment (earth and rockfill) dams. The course begins with the definition and typology of earth dams and the geotechnical characterization of foundation and borrow materials specific to dam projects, then develops the dam-specific investigation program – building on the general subsurface investigation techniques introduced in Soil Mechanics I – that supports embankment design. It then addresses the geotechnical design of the embankment itself: seepage control through cores, cutoffs, and grout curtains; slope stability of the dam faces under steady-state, rapid-drawdown, and seismic conditions; and filter/drain design against internal erosion. The course closes with the instrumentation and monitoring systems used to verify embankment performance, the constructive aspects of foundation treatment and fill placement, and the operational management and safety practices – surveillance, risk assessment, and emergency action planning – required over a dam’s service life.

9.7 CE3H2. General Hydrology

General Hydrology covers the hydrologic cycle processes relevant to water resources engineering: climatology and basic meteorology, measurement and analysis of basin-scale precipitation, hydrometric station networks, and statistical analysis of extreme hydrological events (maximum floods) using probability distributions. The course provides the hydrological analysis tools that support the design of hydraulic and water resources structures in subsequent courses of the Hydraulics line.

9.8 CE3H3. Water Supply and Sewerage

Water Supply and Sewerage is an integrative course that brings together knowledge from hydrology, hydraulics, geotechnics, materials science, environmental chemistry, statistics, optimization, and project management for the design of urban water supply and sanitation systems. The student applies this multidisciplinary foundation to demand projection, the design of distribution and sewer networks, water and wastewater treatment, and the evaluation of sustainability and environmental impact of these systems.

9.9 CE3H4. Water Resources

Water Resources addresses the comprehensive planning of water utilization projects: from the analysis of availability and demand (irrigation, municipal use, energy, navigation, ecological flow) and groundwater hydrology, to the formulation and evaluation of projects through economic, financial, environmental, social, and multi-criteria criteria. The course concludes with the application of

linear programming and system optimization criteria, as well as the operating criteria and the national regulatory framework that govern water resources projects in Peru.

9.10 CE3S11. Professional Competency Workshop - Structures

Professional Competency Workshop - Structures is an integrative review course that consolidates and applies the structural engineering competencies developed throughout the Structures specialization track. It revisits mechanics of materials and structural behavior, standardized testing and quality control, structural dynamics and seismic-resistant engineering, reinforced concrete and prestressed concrete design, structural health monitoring technologies, resilient design for natural hazards and climate change, and engineering ethics and professional responsibility, preparing students to face the professional practice of structural engineering as a whole.

9.11 CE3S4. Earthquake-Resistant Engineering and Disaster Prevention

Earthquake-Resistant Engineering and Disaster Prevention introduces the seismological and regulatory foundations required to design earthquake-resistant civil structures in Peru's highly seismic environment. Students begin with the fundamentals of seismology and plate tectonics, the typology of natural disasters, and disaster risk management, before studying the Peruvian seismic design code (E.030) and the structural configuration criteria – regularity, redundancy, and torsional control – that govern the layout of earthquake-resistant buildings. The course closes with structural dynamics: from single- and multi-degree-of-freedom vibration theory to response-spectrum and modal analysis, providing the analytical foundation for the seismic design of building structures.

9.12 CE3S8. Architecture and Structural Models

Architecture and Structural Models bridges the architectural design studio and the structural engineering practice that supports it. The course opens with the methodology of architectural design and urban planning that civil engineers must understand to collaborate effectively with architects on building and urban projects. It then reviews the analysis of statically determinate structural systems and influence lines, the foundation on which structural models for architectural proposals are built. The course places heavy emphasis on Building Information Modeling (BIM) as the digital platform used to develop, coordinate, and deliver integrated architectural-structural models, and closes with the principles of sustainable and green building systems, and the professional practice skills – technical communication, engineering licensure and legal liability, and global engineering practice – that civil engineers need to operate in multidisciplinary, international project teams.

9.13 CE402. Capstone project I

Este curso tiene por objetivo que el alumno pueda realizar un estudio del estado del arte de un tema escogido para investigar dentro del ámbito de la ingeniería civil. Se busca que el estudiante consolide su base teórica y demuestre capacidad crítica para evaluar soluciones técnicas existentes.

9.14 BLW201. Law and Legislation

Engineers routinely operate within a dense web of legal obligations: they sign and administer contracts, employ and supervise construction personnel, own or encumber the land and equipment their projects require, pay taxes on their professional and business activity, and compete for and execute public infrastructure works regulated by the state procurement system. This course gives future engineers the legal literacy needed to recognize, anticipate, and responsibly manage these obligations. Starting from the foundations of legal theory and the civil law of persons, the course proceeds through obligations and contracts, property and real securities, labor legislation, tax law, and closes with the rules governing public contracting before Peru's public procurement regulator (OSCE), preparing students to interact competently with legal counsel and public authorities throughout their professional careers.

10.1 CE3C11. Sanitary and Electrical Installations

Sanitary and Electrical Installations covers the design of sanitary installations (water supply and wastewater and stormwater drainage) and electrical installations (installed power, maximum demand, lighting, and grounding) within a building.

10.2 CE3G1. Soil Dynamics

Soil Dynamics is an advanced elective of the Geotechnical Engineering track that extends the static shear-strength and deformation framework developed in Soil Mechanics II into the time-varying loading regime relevant to earthquakes and vibrating machinery. The course begins with the theoretical foundations of single-degree-of-freedom dynamic systems and one-dimensional wave propagation through soil deposits, then develops the tools needed to characterize seismicity, process strong-motion signals, and determine the dynamic properties of soils from laboratory and field testing. This foundation supports the analysis of seismic site response and the seismic stability of slopes, retaining structures, and foundations, and is applied to two design problems of markedly different scale: the design of foundations for vibrating machinery under steady-state dynamic loads, and the assessment, mitigation, and post-earthquake analysis of soil liquefaction, including the residual strength of liquefied soils. As a specialization elective following Soil Mechanics I and II, the course prepares students to perform the seismic geotechnical analyses required in professional practice in a seismically active country.

10.3 CE3G2. Soil Mechanics Applied to Foundations

Soil Mechanics Applied to Foundations is a specialization elective of the Geotechnical Engineering track, taken after Soil Mechanics II, in which the foundation-design and slope-stability topics introduced there at a survey level are revisited in substantially greater depth. The course opens with the identification and classification of foundation soils – including problematic soils such as expansive, collapsible, and dispersive soils, and engineered fills – and the site-investigation criteria required under Peru’s RNE Norma E.050. It then develops ground improvement techniques for weak or hazard-prone soils, extends bearing capacity theory to stratified profiles, sloping ground, and seismic loading, and deepens the design of both shallow and deep foundations, including pile load testing and integrity testing. The course closes with the static and pseudo-static (seismic) stability analysis of slopes. Together, these topics prepare students to characterize difficult foundation conditions and design the full range of foundation solutions encountered in professional geotechnical practice.

10.4 CE3G7. Professional Competencies Workshop - Geotechnical

Professional Competencies Workshop is the capstone/synthesis course of the Geotechnical Engineering specialization track. It integrates, around real project scenarios, the shear-strength and stress-distribution framework and the site investigation and in-situ testing techniques developed earlier in the track with the four principal design domains of geotechnical practice: slope stability and landslide mitigation, geotechnical earthquake engineering and liquefaction, shallow and deep foundation design, earth retaining systems, ground improvement and geosynthetics engineering, and the geotechnical design of earth and rockfill dams – including dam typology selection and the geotechnical characterization of foundation and borrow materials that supports that design. Rather than introducing new content, the workshop revisits and applies, at a professional level of integration, the knowledge units developed throughout the specialization’s preceding courses.

10.5 CE3H5. Introduction to Fluvial Hydraulics

Introduction to Fluvial Hydraulics covers the behavior of natural channels under the action of flow and sediment transport: from basin erosion and sediment properties, through the calculation of bed load, suspended load, and total load, to the analysis of scour and fluvial morphology using tools such as the Lane balance. The course culminates with the design of channel stabilization and bank protection works, reservoir sedimentation management, and an introduction to river navigation.

10.6 CE3H6. Irrigation Engineering

Irrigation addresses the comprehensive design of irrigation projects: from the context of Peruvian agriculture and the soil-water-plant relationship, the esti-

mation of evapotranspiration and agricultural water demand, to the hydraulic sizing of dams and reservoirs, the design of intake structures (diversion weirs, desanders) and conveyance structures (canals), and the agronomic and hydraulic design of gravity and pressurized irrigation systems (including drip irrigation). The course concludes with the evaluation of irrigation projects from environmental, social, and economic perspectives.

10.7 CE3H7. Hydraulic and Hydrology Engineering Workshop

Hydraulic and Hydrological Engineering Workshop is an applied course on dam design: it begins with hydraulic planning (water availability and demand, reservoir sizing methods) and then covers the engineering and structural design of gravity concrete dams, hollow gravity dams, earthfill dams, and rockfill dams, including stability and seepage analysis, and the design of associated intake, diversion, and control structures.

10.8 CE3S10. Seismic Design of Civil Engineering Works

Seismic Design of Civil Engineering Works introduces the seismic analysis and reinforced concrete design of special/industrial civil engineering structures – free-standing chimneys and liquid-storage tanks – extending the seismological, code, and structural-dynamics fundamentals from Earthquake-Resistant Engineering to structures whose seismic behavior differs fundamentally from that of buildings. The course opens with the professional and regulatory context of civil engineering works, framing the elevated public-safety risk profile of special/industrial structures, then reviews the seismic phenomenon, the Peruvian seismic design code, and the fundamentals of structural dynamics before applying them to the seismic analysis and reinforced concrete design of chimneys – modeled as equivalent cantilever systems – and liquid-storage tanks, whose seismic response is governed by the hydrodynamic impulsive-convective interaction between the contained liquid and the tank walls, following ACI 307 and ACI 350.3.

10.9 CE3S12. Research Workshop

Research Workshop introduces students to the fundamentals of engineering research methodology in preparation for capstone-level research work in Civil Engineering. Students learn to identify a research idea and formulate a research problem, build the theoretical and conceptual framework that supports a study, formulate testable hypotheses and operationalize the variables involved, select and justify an appropriate type and design of research, and collect and analyze data to answer a civil engineering research question. The course also reinforces the professional ethics and technical communication skills required to conduct and disseminate engineering research responsibly.

10.10 CE3S2. Reinforced Concrete Design II

Reinforced Concrete Design II builds directly on Reinforced Concrete Design I, extending limit state design methodology to the structuring and design of building slab systems, seismic-resistant reinforced concrete structural walls (shear walls) and special moment frame provisions, and the use of structural analysis software for three-dimensional building modeling. The course also develops earth-retaining structure design, including basement walls, anchored walls, gravity walls, and cantilever and counterfort retaining walls, together with advanced shallow foundation design covering isolated, combined, connected, eccentric, and continuous footings. Through progressive, integrated design exercises, students apply current design codes to produce a complete seismic-resistant reinforced concrete building design, preparing them for advanced structural and earthquake-resistant design coursework.

10.11 CE3S6. Masonry, Adobe, and Timber

Masonry, Adobe, and Timber covers the seismic-resistant design of low-rise buildings using the structural systems most widely used in Peruvian construction: structural masonry, adobe, and timber. Building on the seismic engineering fundamentals from Earthquake-Resistant Engineering, the course develops a design studio that applies material selection criteria, seismic code requirements, and structural detailing to complete building design projects in masonry, adobe, and timber.

10.12 CE3S7. Structural Rehabilitation and Retrofitting

Structural Rehabilitation and Retrofitting addresses the assessment, strengthening, and retrofit of Peru's existing civil infrastructure. Building on the seismic engineering fundamentals of Earthquake-Resistant Engineering and Disaster Prevention, the course begins with the national context of Peru's aging and deficient infrastructure and a review of the seismic design code criteria that establish the baseline performance expectations against which existing structures are evaluated. Students then characterize the permanent, live, environmental, and deterioration-induced loads acting on existing structures, and study the nonlinear behavior of structural components – including hysteretic response, plastic hinge modeling, and pushover analysis – required to evaluate structural performance beyond the elastic range. The course closes with the field evaluation procedures, and the strength, ductility, durability, and serviceability rehabilitation techniques used to retrofit existing structures.

10.13 CE403. Capstone project II

Este curso tiene por objetivo que el alumno desarrolle su propuesta técnica y sus experimentos en base al estado del arte ya levantado previamente. Es la etapa de consolidación donde se define el aporte original o la aplicación novedosa de la ingeniería civil que dará lugar a su tesis profesional.

10.14 CE3C12. Costs and Budgeting (Elective)

Costs and Budgets deepens the estimation of construction costs, quantity take-offs and unit price analysis, the total budget and its adjustments, and the management and control of costs of a construction project.

10.15 CE3C13. Project Planning and Control (Elective)

Project Planning and Control introduces strategic planning and management plans according to the PMBOK guide, project planning, scheduling, and control using the Critical Path Method (CPM) and 4D/5D modeling, project management and control philosophies, and the soft and managerial skills necessary to lead project teams.

10.16 CE3C14. Sustainable and Resilient Infrastructure

Sustainable Infrastructure covers the principles, planning, design, materials, and management of sustainable infrastructure: the triple bottom line, life-cycle thinking, resource efficiency, the circular economy, and the social, economic, and governance dimensions of sustainable infrastructure projects.