

## Engineering Course Catalogue 2017

University Catalogue (in Spanish) available in: [catalogo.uniandes.edu.co](http://catalogo.uniandes.edu.co)

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
<b>Biomedical Engineering</b>							
IBIO	1010	Biomedical Engineering	Introduction to Biomedical Engineering	The course is intended to provide first semester students the necessary skills to identify, explain and apply basic concepts and tools in Biomedical Engineering, and those common to other Engineering domains, in the understanding and solution of problems in biology and medicine. After this course, the student will be able to differentiate Biomedical Engineering from other Engineering disciplines, as well as, to develop appropriate skills on communication, teamwork and evaluation. The course will provide students the necessary skills to identify, interpret and execute the different rights and duties she/he acquires as student of the University of Los Andes as well as the services the university offers.	None	None	3
IBIO	2099	Biomedical Engineering	Quantitative Physiology for Biomedical Engineering I	This course provides basic knowledge of human physiology, emphasizing mechanisms of regulation, control, and homeostasis, as well as the physiological characteristics and main pathophysiologicals in the main systems of the human body. Throughout the course, the basic concepts regarding cellular physiology and the nervous, muscular, cardiovascular and respiratory systems will be covered. Each module studies fundamental aspects of each system through a theoretical approach, involving the use of engineering tools such as modeling and simulation. These class sessions will be followed by a laboratory session focused on the anatomy and basic physical principles related to the given system's physiological functions. In this course, students are expected to be able to follow the theoretical sessions after reading the assigned lectures.	None	None	3
IBIO	2102	Biomedical Engineering	Quantitative Physiology for Biomedical Engineering II	This course provides students with basic knowledge on human physiology, taking into account mechanisms of regulation and homeostasis, as well as the physiological and pathophysiological characteristics of each of the body's main organ systems. It is divided into two parts covering different organ systems: Quantitative Physiology I covers cellular physiology and the nervous, muscular, and endocrine systems, while Quantitative Physiology II includes the cardiovascular, respiratory, urinary, and digestive systems. Each module begins with an overview of the particular system's anatomy, followed by a discussion of the basic physical processes related to physiological function, allowing students to acquire abilities for the quantification of different physiological processes. Students will be able to apply and reinforce this theoretical knowledge in the laboratory and complementary class sessions. This course is mandatory for the Biomedical Engineering program.	None	IBIO 2099 - Quantitative Physiology for Biomedical Engineering I	3
IBIO	2240	Biomedical Engineering	Scientific Programming	The course provides the students the basic programming tools and numerical methods for the solution of different problems in biomedical engineering. It presents first the basic concepts of some computational tools (focused on MATLAB), followed by the study and computational implementation of some of the most common numerical methods employed in the analysis in engineering contexts.	None	ISIS 1204 - Algorithmics and Object-Oriented Programming I, MATE 1214 - Integral Calculus and Differential Equations, MATE 1105 - Linear Algebra I	3
IBIO	2260	Biomedical Engineering	Biomedical Systems Modelling and Simulation	Introduction to dynamical systems and their applications in Biomedical engineering. Applications to physiological systems to expand the understanding of its operation and control. Also present an introduction to population biology in order to understand the dynamics of populations including the concepts of competition and coexistences using deterministic and stochastic models, continuous and discrete.	None	IBIO 2250 - Biologic Transport Phenomena, LENG 2999 - English Reading Requisite	3
IBIO	2250	Biomedical Engineering	Transport Phenomena in Biological Systems	Heat, mass and momentum transport processes are encountered in numerous biological problems and show considerable physical and mathematical similarities among them. A fundamental understanding of the conservation principles and constitutive laws that govern such processes is crucial for analyzing and addressing current and novel medical devices and treatments. During the course of the term, various topics of biomedical relevance will be covered including the transport of species at the cellular and physiological level, the transport characteristics of membranes, the rheology of blood, alveoli oxygen transport and the kinetics of chemical reactions.	None	IBIO 2102 - Quantitative Physiology for Biomedical Engineering, IBIO 2240 - Scientific Programming; MATE 1207 - Vector Calculus, FISI 1028 - Physics II, MBIO 1100 - Cell Biology	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IBIO	2560	Biomedical Engineering	Biomedical Signals Processing and Instrumentation	The study of signals and systems is a fundamental requirement in the basic engineering training. Not only the signals are one of the main sources of information available in the different engineering fields of action, but also, their study allows the understanding of associated systems which they interact with. Biomedical signals in turn, or more generally, signals from living organisms, are one of the main sources of information available for the understanding of the way the various systems (e.g. organs) that produced them interact with each other. Through their study it is also possible to identify both normal and pathological contexts in which their processing and analysis may prove useful for clinical diagnosis and treatment. This growing interest in the study of biomedical signals has produced the development of a variety of devices that facilitate their registration and analysis, and are closely related to technological advances in instrumentation (measurement).	None	IELE 1010 - Circuits and instrumentation, LENG 2999 - English Reading Requisite, IBIO 2240 - Scientific Programming, MATE 1207 - Vector Calculus	3
IBIO	2650	Biomedical Engineering	Biomaterials	Biomaterials are synthetic or natural materials used either to increase or permanently replace a tissue or for applications requiring a relatively short time. A wide range of materials are employed in the construction of biomedical devices such as artificial blood vessels, heart valves, cosmetic implants, orthopedic joints, dental fillings, intravenous catheters and vehicles for the controlled delivery of drugs. This course shows the basic biological systems that govern the use of biomaterials and the range of materials currently used in biomedical applications.	None	IBIO 2102 - Quantitative Physiology for Biomedical Engineering, QUIM 1301 - Organic Chemistry	3
IBIO	3160	Biomedical Engineering	Biomechanics	Biomechanics is the application of mechanical theories in biomedical engineering. This course contains the fundamentals of mechanical engineering theories (kinematics, statics, dynamics, control, and solid mechanics) and their applications in biomedical engineering. We will put special emphasis on dynamics of human motion and tissue mechanics. Students will conduct experiments and computer simulations in the lab to understand how the biomechanics can be applied to more practical situations.	LENG 2999 - English Reading Requisite	IBIO 2102 - Quantitative Physiology for Biomedical Engineering	3
IBIO	3270	Biomedical Engineering	Experimental Design and Biostatistics	The course aims to guide students in planning, design and execution of experiments efficiently and effectively, evaluating data statistically to make appropriate conclusions. With the development of knowledge in this area the student can apply the principles taught in the course in all phases of engineering and scientific work, including the study of clinical trials, the development of technologies, the design of new products and processes and the improving of manufacturing processes. Based on the above, the student is expected to understand the methodology and logical steps in experimentation, which can be summarized as: planning, conduct and analysis. In Biomedical Engineering, a well-designed clinical trial can lead to an effective analysis of medical problems, a reduction in the number of experiments, a reduction in the time to develop new processes and products and to an improved performance manufacturing processes and products that have superior functionality and reliability.	None	IBIO 2240 - Scientific Programming, IIND-2106 Probability and Statistics I	3
IBIO	3470	Biomedical Engineering	Biomedical Imagen Analysis	This course introduces the field of digital image processing and analysis as a tool to extract quantitative information from visual data in real-world multidisciplinary biomedical applications. The theoretical lectures present general techniques and concepts of this area, while the hands-on laboratory sessions are devoted to their practical application using the MATLAB programming environment. The course is organized around a final research project, which the students develop in groups throughout the semester.	None	IBIO 2240 - Scientific Programming	3
IBIO	2780	Biomedical Engineering	Design Project 1	This is a design course and it is based on a project. Students, through the logic of design thinking, will address and develop a solution to a health issue from a biomedical engineering perspective. This course is part of the Design Project 1 and 2 sequence. During the first part, the students will identify a health need, will develop a clear need statement, will investigate existing solutions, will analyze the stakeholders affected by their solution, get an idea of the market opportunity, will develop a value proposition and will propose a solution in order to address the need. At the end of the semester, students must have conducted an experiment to validate the feasibility of their proposed solution, also known as a 'killer' experiment. The success of this experiment will enable the students to continue the development in the following course of Design Project II.	None	IBIO 1010 - Introduction to Biomedical Engineering, IBIO 2102 - Quantitative Physiology for Biomedical Engineering, IELE 1010 - Circuits and instrumentation, Spanish Requisite (LENG 1501 or LITE 1611),	3
IBIO	3870	Biomedical Engineering	Design Project 2	This is a design course and it is based on a project. Students, through the logic of design thinking, will address and develop a solution to a health issue from a biomedical engineering perspective. This course is part of the Design Project 1 and 2. In this first semester, students will identify a health need and will develop a value proposition and solution proposition in order to address it. At the end of the semester, students must have conducted a killer experiment that will serve to evaluate the concept and so be able to continue their project the following semester.	None	IBIO 2780 - Design Project I, IBIO 2560 - Signal Processing and Biomedical Instrumentation, IBIO 2260 - Biomedical Systems Modelling and Simulation, IBIO 2650 - Biomaterials, IIND 2401 - Investment Decision Analysis.	3

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<b>Civil and Environmental Engineering</b>							
ICYA	1101A	Civil and Environmental Engineering	Introduction to Environmental Problems	The objective of the course is to develop in the students an environmental ethics based on biological, social and economic characteristics of the Colombian society. Simultaneously, the following topics are offered: history of life on Earth, environmental catastrophes, environmental impacts of human activity, public health, and water pollution.	None	None	3
ICYA	1110	Civil and Environmental Engineering	Environmental Chemistry	This class is an introduction to the basic concepts of chemistry in environmental systems. It seeks to apply these concepts to the pollution problems or environmental degradation in water, air and soils.	None	QUTM 1103 - General Chemistry.	3
ICYA	1113	Civil and Environmental Engineering	Introduction to Environmental Engineering	This course presents the student with a general view of the most important areas of Environmental Engineering, as well as current environmental problems and their impact on society. This course provides an introduction to the problems associated to water, air and soil; the alternatives to mitigate or remediate possible impacts and prevent environmental quality deterioration. Environmental Engineering basic concepts are presented, including principles and applications in engineering to the quality control and pollution of water, solid waste management and air quality control. The central axis of this course is the development of a project which seeks to develop basic engineering and research abilities of freshmen.	None	None	3
ICYA	1114	Civil and Environmental Engineering	Introduction to Civil Engineering	The objective of the course is to introduce the students to the meaning of their profession, the subject's fields of application, the education provided by the university, and spectrum of job opportunities open to a civil engineer graduated from Universidad de Los Andes. After completing this course, the student will be able to work in teams, identify and recognize the fields of application for civil engineering in a national and international context, explain the relationship of this engineering with others, and understand the ethical and professional responsibility that he or she should have with the country.	None	None	3
ICYA	1116	Civil and Environmental Engineering	Statics	The Static studies the statics of non-deformable bodies. It studies the conditions due to which solid bodies (buildings, bridges, dams, cantilevers, trusses, etc.) keep their equilibrium position under applied forces. The objective of the course is to introduce the student to the basic principles of toe mechanics of solid bodies and its application in the solution of engineering problems. Adjacent to this content, the course includes an introduction to computational mechanics and the management of uncertainty in engineering. By the end of the course the student must be able to individually deal with problems involving the statics of solid bodies, solving it in an efficient, logical, and consistent manner. The course seeks to develop the abilities for the solution of basic rigid body problems. Furthermore, through different activities, it is expected that the students develop analysis, communication, critical thinking, and teamwork abilities.	None	FISI 1018 - Physics I, MATE 1203 - Differential Calculus	3
ICYA	1117	Civil and Environmental Engineering	Mechanics of Materials	The course objective is to develop in students the ability to analyze a mechanical problem in a simple and logical form, using, in their solution, the fundamental principles of the mechanics of materials. It first and foremost seeks to familiarize students with the concepts of stress and strain and their main applications.	None	ICYA 1116 - Statics	3
ICYA	1120	Civil and Environmental Engineering	Civil Engineering Surveying	The course objective is to provide students with theoretical and practical elements necessary to make use of the surveying in engineering projects. The topics included are: measuring tape, angles and directions, surveying sites, survey of land with tape only, topographical drawing, areas calculation, the compass and their applications, introduction to the elevation, different types of levels, simple and compound direct leveling, leveling lines - profiles , leveling of land - contours, leveling networks, surveying with transit and tape, tachometry, triangulations and trilateral, sub-tense bar, earthworks, basic knowledge of plot, basic knowledge of photogrammetry, electronic measurement of distances.	None	FISI 1018 - Physics I, MATE 1203 - Differential Calculus	3
ICYA	1122	Civil and Environmental Engineering	Materials in Civil Engineering	Introduction to materials science, with an emphasis on inspection and testing of the materials most commonly employed in civil engineering. In the class sessions, the course takes a detailed look at the mechanical properties and the production processes (or treatment) of structural steel, hydraulic concrete, masonry, wood, asphaltic materials and plastics. The course is accompanied by laboratory tests used in civil engineering and their relationship to the analysis of the mechanical behavior of materials. Topics being discussed include: cementitious materials, Portland cement, concrete water content, aggregates in concrete, properties of fresh and hardened concrete, concrete mix design, ferrous materials, wood, and plastics.	None	ICYA 1116 - Statics	3
ICYA	1125	Civil and Environmental Engineering	Geomatics	At the end of the course, the student will understand and will be able to apply all the principles of the measurement of land and spatial analysis techniques. In addition, it is expected that the student will develop an individual approach and use that as the best tool for data gathering, analysis and presentation. The final purpose of this is to understand the land administration system in order to make decisions based on a technical, legal and professional framework.	None	MATE 1203 - Differential Calculus	3

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ICYA	2001	Civil and Environmental Engineering	Modeling and Numeric Analysis	There is a great amount of real engineering problems whose governing equations do not allow the development of exact analytical solutions. Their solution requires the implementation of approximate solutions by means of numerical methods. This course presents an introduction to numerical methods and focuses on the implementation of computational algorithms to solve engineering problems using these approximate methods. The course also analyzes different topics, such as equation roots, Linear systems of equations, optimization, numerical integration and differentiation, and problems that involve the solution of ordinary and partial differential equations.	None	MATE 1207 - Vector Calculus, ISIS 1204 - Algorithmics and Object Oriented Programing I	3
ICYA	2101	Civil and Environmental Engineering	Environmental Thermochemistry	The course introduces the basic concepts of mass and energy balance and thermodynamics applied in the Environmental Engineering field. Included topics are: basic concepts and units, process variables, mass balance, general concepts in thermodynamics, pure substance properties, First Law of Thermodynamics, other thermodynamic concepts. At the end of this course, the student will be able to perform overall mass balances, and specifically to environmental processes. Understand the thermodynamic properties of pure substances. Perform energy balances of great importance in the environmental field.	None	ICYA 1100 - Environmental Chemistry	3
ICYA	2203	Civil and Environmental Engineering	Structural Systems Analysis	The course objective is to train students in the application of basic concepts to understand the behavior of the structures most commonly used in civil works. After completing this course, students will be able to individually address any problem involving the static solution of deformable bodies and have a clear understanding of its behavior. Topics being tackled include: types of structures and loads, idealization and modeling of structures, traditional methods, approximate methods, direct stiffness method, and lines of influence.	None	ICYA 1117 - Mechanics of Materials	3
ICYA	2301	Civil and Environmental Engineering	Geosciences	The course treat the dynamics of planet earth, understood as the dynamic of the planet and between its components. The course is divided in three parts: The lithosphere, the atmosphere, and the hydrosphere. The first part deals with the dynamics of the solid component of the planet from its origin as part of the solar system to the actual structure and composition of planet earth. The part corresponding to the atmosphere deals with the physical and chemical properties of it, clouds formation, precipitation, winds, sea currents, weather, climate change and atmospheric damage. The liquid component of earth deals with the processes on the earth surface and the surface layers of the sub ground related with the influence of water in landscape formation within the geomorphologic cycle.	None	None	3
ICYA	2304	Civil and Environmental Engineering	Fundamentals of Geotechnical Engineering	This course introduces the students to geotechnical area through two components: theoretical and experimental. The theoretical component deals with the basic concepts and tools of soils mechanics and its application in geotechnical engineering. In the experimental component, the students perform, analyze, and interpret the principal laboratory tests used in geotechnical engineering.	None	ICYA 1117 - Mechanics of Materials	3
ICYA	2401	Civil and Environmental Engineering	Fluid Mechanics	The objective of the course is to introduce the students to fluids, their physical properties, and mechanical behavior. By the end of the course, students will be able to understand the behavior of fluids in different engineering situations, based on the use of physics equations and numerical methods to facilitate the calculations. The fluid studied on the course is water, its applications, drinking water supply problems, and the collection and evacuation of residual and pluvial water and hydraulic structure operation among others. During the course, the students use concepts such as open channel hydraulics, hydrology, river hydrology, hydraulic structures and groundwater. Concepts and equations of mass, momentum, and energy conservation are also introduced and applied in the context of fluids. Particular emphasis is placed on friction loss and its effect on the design of engineering systems related with water treatment. In general, the following topics are covered: fluids properties, fluids statics, fluid kinematics and conservation laws, behavior of real fluids (shear stresses, velocity distribution and energy loss), dimensional analysis and dynamic similarity, flux in pressurized pipes, pipes design, applications.	None	MATE 1214 - Integral Calculus and Differential Equations, FISI 1018 - Physics I	3
ICYA	2402	Civil and Environmental Engineering	Hydraulics	The hydraulics course aims to introduce the student to the concepts of water movement mechanics in open flumes in order to be able to understand the behavior of this flow in the different applications of civil and environmental engineering, particularly in relation to drinking water supply and collection and disposal of wastewater in an urban environment. Other applications are hydraulics of rivers, irrigation districts and hydraulic structures associated with dams, treatment plants and pumping stations. The topics covered on the course are: application of the conservation equations of mass, momentum and energy, learned on the fluid mechanics course; the case of free surface flows; specific energy and specific momentum channels; uniform flow in partially full pipes and natural and artificial channels with gradually and rapidly varied flow; design of hydraulic structures; and unsteady flow in open channels.	ICYA 2001 - Modeling and Numerical Analysis	ICYA 2401 - Fluid Mechanics	3
ICYA	2406	Civil and Environmental Engineering	Drinking-Water Treatment	This course studies the principles of physical-chemical treatment of drinking waters. The course provides a basis for the analysis and dimensioning of conventional treatment technologies using theoretical concepts and technical recommendations.	ICYA 2401 - Fluid Mechanics.	ICYA 1110 - Environmental Chemistry.	3

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ICYA	2407	Civil and Environmental Engineering	Environmental Microbiology	This course provides a general introduction to microbial biology and physiology, as well as to the main applications, positive and negative roles of microorganisms in the environment.	BIOL 1327 - Ecology, Principles and Applications.	ICYA 2101 - Environmental Thermochemistry.	3
ICYA	3078	Civil and Environmental Engineering	Final Design Project in Civil Engineering	This course will expose the student, through a realistic design project, to the local reality of a region and to the role of civil engineers in professional practice. The project consists of the resolution of a civil engineering-related problem that is characterized for being framed in a complex context. The course is based on the execution of a design project by stages, in which students work in teams to integrate and apply the acquired concepts in the fundamental and intermediate courses of the Civil Engineering Program.	None	LENG 2999 - English Reading Requisite, ICYA 3202 - Structural Design, ICYA 3203 - Construction Project Management, ICYA 3305 - Geotechnical Structures, ICYA 3306 - Transportation Systems	3
ICYA	3079	Civil and Environmental Engineering	Final Design Project in Environmental Engineering	The objective of this course is to link the student to the real situation and regional problems through a design project; directed towards the resolution of a Environmental Engineering problem in an open, real and complex context. The course is based on the execution by stages of a project, in which the students will have to efficiently work in teams, to integrate and apply the acquired concepts in the fundamental and intermediate courses of the Environmental Engineering Program.	None	LENG 2999 - English Reading Requisite	3
ICYA	3103	Civil and Environmental Engineering	Graduation Project in Environmental Engineering	Graduation project is a course for which the ABET assessment and evaluation strategies are still on development. This is one of the improvement measures that have been identified in this process.			3
ICYA	3202	Civil and Environmental Engineering	Structural Design	The course covers the behavior of reinforced concrete as structural material in order to understand the fundamentals of its design. An introduction to concrete structural systems is included, policies, regulations and codes that rule its design (Colombian earthquake-resistant construction regulation - NSR-10), structural security concepts, design loads, and the behavior and design premises of reinforced concrete. The following topics are also covered on the course: the physical and mechanical properties of concrete and reinforcement steel: the fundamentals of structure construction with reinforced concrete; the behavior of reinforced concrete elements under axial load (with no momentum); the design of elements under flexion and shear stress; the adherence, anchorage, and reinforcement steel junctions; the function and flexion of reinforced concrete elements; the behavior and design of columns under flexo-compression, including the slenderness problem; slabs in one and two directions; the principles of concrete structure analysis; and foundation, stairways, and ramps design. The last topic covered is the design of earthquake-resistant reinforced concrete frames and walls.	None	ICYA 1122 - Materials in Civil Engineering, ICYA 2203 - Structural Analysis	3
ICYA	3203	Civil and Environmental Engineering	Construction Project Management	The construction sector in Colombia is one of the main lines of economic development. This course is responsible for presenting a panorama of the construction from the civil engineer's point of view, framed in the management of projects, which have clearly identified characteristics and life cycles. Through the different concepts presented on the course, the student is introduced to the knowledge areas applicable to the development of construction projects, which are needed to efficiently and effectively attain the frame components (scope, time, cost and quality). After completing this course, the students are familiar with tools that will allow them to work with interdisciplinary teams and have the ability to coordinate different aspects relevant to the management of construction projects.	None	IIND 2401 - Investment Decision Analysis	3
ICYA	3305	Civil and Environmental Engineering	Geotechnical Structures	Civil engineers frequently face problems related with the design, building, maintenance, and eventual repair of structures for which the terrain is a component. The design of those structures is controlled by the strain and stresses in the soil and in the materials that compose the structures. The course presents a description of a wide variety of geotechnical structures analyzing their performance. The types of geotechnical structures analyzed and designed are: pavements, shallow and deep foundations, retaining walls, and an introduction to slope stability.	None	ICYA 2304 - Fundamentals of Geotechnical Engineering	3
ICYA	3306	Civil and Environmental Engineering	Transportation Systems	The course studies transport and traffic engineering principles, providing tools to help understand the disciplines in a technical manner within the interdisciplinary framework. Other topics covered are: the concepts and principles of traffic engineering; description of transport modes; public transportation; transport modeling principles and basic criteria for transport systems design; and the relation of transportation with economy, construction, energy, and the environment.	None	IND 2106 - Probability and Statistics I	3
ICYA	3307	Civil and Environmental Engineering	Highway Geometric Design	The course studies the principles of highway design within the current regulations, providing tools to understand the discipline technically within an interdisciplinary framework. The course reviews the highway design criteria for horizontal, vertical alignment, cross section and soil movement together with the relationships between construction, transport, economy and the environment. Computational tools are employed to improve, optimize and quantify vial projects.	ICYA 3306 - Transportation Systems	ICYA 1125 - Geomatics	3

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ICYA	3401	Civil and Environmental Engineering	Hydrology	Hydrologic cycle, Earth's energy balance, atmospheric circulation, macroclimatic phenomena. Physical description, measurement and analysis of hydrometeorology processes of the hydrologic cycle: precipitation, interception, evaporation, transpiration, infiltration, and runoff. Water balance in watersheds. Groundwater hydrology. Precipitation runoff relations. Hydrographs. Hydrologic routing in reservoirs and channel reaches. Hydraulic routing in rivers. Hydrologic hazard, vulnerability and risk. Frequency analysis of hydrologic extreme events. Intensity-Duration-Frequency curves and design hyetographs. Regional frequency analysis. Hydrologic design.	ICYA 3407 - Hydraulics.	IIND 2106 - Probability and Statistics I.	3
ICYA	3406	Civil and Environmental Engineering	Environmental Process Modeling	Environmental modeling deals with general and practical topics of tools and methods of mathematical modeling of processes in the environment. Processes of transport, mass transfer and biochemical transformations of solutes, organic matter, nutrients, toxics and microorganisms in air, water and soil, are mainly studied.	ICYA 3401 - Hydrology	None	3
ICYA	3408	Civil and Environmental Engineering	Waste-Water Treatment	This course presents a general view of domestic and urban wastewater treatment. Basic concepts and fundamentals necessary for the design of some physical, chemical and biological processes in environmental engineering, are studied. Although a very important part of the subject is devoted to water treatment, this is not a specific process design course.	None	ICYA 2406 - Drinking-water Treatment, and ICYA 2406 - Environmental Microbiology	3
ICYA	3501	Civil and Environmental Engineering	Air Quality and Meteorology	This course covers a wide variety of subjects including an historical perspective of the air pollution problem, basic concepts and definitions regarding air pollution, atmospheric transformations, air pollutants classification, criteria pollutants, health and environmental effects, particulate matter, concentration units, ideal gas law, environmental law, air quality standards, air pollution in Bogota: a case study, air pollutant emission inventories, mobile and stationary sources, biogenic sources, AP-42 and IVE methodologies, the internal combustion engine, Otto and Diesel cycles, incomplete combustion, fuels: natural gas vs. gasoline vs. diesel, the catalytic converter, climate change: sources and implications, the stratospheric ozone layer, Kyoto and Montreal protocols, atmospheric chemistry and physics, temperature profiles, the wind rose, atmospheric stability, emissions control technologies and Gaussian dispersion model.	None	ICYA 2401 - Fluid Mechanics, ICYA 2101 - Environmental Thermochemistry.	3
ICYA	3601	Civil and Environmental Engineering	Environmental Impact Assessment and Auditing	Environmental Engineers frequently conduct environmental impact assessments during the planning and design stages of a Project. Once the project has been finished and is in operation, it is important to monitor the impact of the project on both the environment and health of the surrounding community. The objective is that at the end of this course, the students recognize the requirements, methods, and tools used to evaluate the environmental impact and health risks associated with different types of projects.	None	All level 1 courses should have been passed	3
ICYA	3605	Civil and Environmental Engineering	Geographic information Systems and Environmental Planning	Geographic information management is essential in any project related to natural resources planning. Good management and planning of these phenomena or resources requires locating and monitoring them, allowing the arrangement or interpretation of their changes. This course intends to provide the theoretical and practical elements necessary to formulate appropriate solutions to the different problems that appear in environmental management. Using Geographic Information Systems, students will develop the ability to manage and analyze geographic information, simulate and model impacts that solve and help decision-making by the generation of spatial knowledge for environmental planning. It will allow the understanding of basic cartography concepts, remote perception and Global Positioning System –GPS-, allowing the development of spatial analysis abilities, through multi-criteria and multi-objective assessment.	None	LENG 2999 - English Reading Requisite	3
ICYA	3702	Civil and Environmental Engineering	Solid Waste Management	Introduce students to Solid Waste Management, especially city solid waste. Types, sources, composition, quantity and characteristics of solid waste are presented, due to the significance of this knowledge for the appropriate management of waste. This course provides basic tools of analysis and design of the different chain components, part of the solid waste management, including their collection and transport, employment, treatment and final disposal. Additionally, environmental, economic and social impacts due to a lack of proper disposal of waste are discussed.	None	ICYA 1120 - Civil Engineering Surveying, ICYA 2101 - Environmental Thermochemistry	3
<b>Electrical and Electronic Engineering</b>							
IELE	1000	Electrical and Electronic Engineering	Introduction to Electrical and Electronic Engineering	The course represents the first contact between the students and the program of Electronic Engineering. It introduces the action fields where an engineer can contribute and develop his knowledge in Colombia and around the world. Furthermore, the course serves as a counseling space for first semester students, in order to make easier the university adaptation for them. Finally, the course has a project where the students are introduced to tools, topics and contents of the program.	None	None	3

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IELE	1002	Electrical and Electronic Engineering	Fundamentals of Electrical Circuits	Comprehend the basic physical laws that describe phenomena that occur in electrical circuits at low frequencies, including zero frequency, as well as the effect of resistances, inductances and capacitances and their physical variables, both at transitory and permanent state, in temporary and frequency response. "Comprehend" is understood as having the ability to apply what has been learned in the solution of a sufficiently open problem.	None	MATE 1214 - Integral Calculus and Differential Equations MATE 1105 - Linear Algebra I	3
IELE	1006	Electrical and Electronic Engineering	Electrical Circuits	This course presents the principles of electrical circuits. Different circuits analysis methods are studied with the purpose that the student be capable of choose the appropriate method for a specific problem. Also, the student will be able to understand the operation of the basic elements in circuits. Complex function circuits are developed taking into account basic function circuit block. Also, the student will be able to understand the operation of the basic elements in circuits, sensors, filters and instrumentation amplifier.	None	MATE 1214 - Integral Calculus and Differential Equations, MATE 1105 - Linear Algebra I	3
IELE	1010	Electrical and Electronic Engineering	Electrical circuits and instrumentation	This course presents the principles of electrical circuits. Different circuits analysis methods are studied with the purpose that the student be capable of choose the appropriate method for a specific problem. Also, the student will be able to understand the operation of the basic elements in circuits, sensors, filters, instrumentation amplifier and isolation amplifier.	None	MATE 1214 - Integral Calculus and Differential Equations, MATE 1105 - Linear Algebra I	3
IELE	1204	Electrical and Electronic Engineering	Materials and Semiconductor Devices	Crystal structure, mechanics, quantum and statistical. Piezo and ferroelectricity, magnetic properties of solids. Free electron. Band theory. Semiconductors. Photoelectric effect. PN junction. Junction transistor, characteristics. FET characteristics. PIN and MOS. Electrical noise.	None	None	3
IELE	1400	Electrical and Electronic Engineering	Fundamentals of Network	Computer networks: Multilayered architecture concept and their service models. The course introduce and explain the concepts of layers (transport, network, data-link, physical) and the basic principles of LAN networks. The practical part consist of simulations in software.	None	ISIS 1204 - Algorithmics and Object-Oriented Programming I	3
IELE	1502	Electrical and Electronic Engineering	Dynamic Systems	This course addresses the modeling, simulation, and analysis of Linear dynamic systems using differential equations, Laplace transform and difference equations. The course is developed around 5 or 6 modeling projects of real systems through data acquisition systems. In parallel, the students will work analytically with differential equations and transfer functions, as well as the solutions of these equations.	None	MATE 1214 - Integral Calculus and Differential Equations, FISI 1028 - Physics II	3
IELE	2000	Electrical and Electronic Engineering	Electrical circuits analysis and synthesis	AC single phase power. Multiphase systems. Phase power. Magnetic coupling. Transformers. Laplace transform and its applications to circuits. Filtering. Analysis in the frequency domain. Resonance and harmony. Analysis of two port networks, Elements of theory of realizability. Basic synthesis impedances and transfer functions. Passive filter design.	None	None	3
IELE	2002	Electrical and Electronic Engineering	Electromagnetic Theory	In this course, the student acquires the ability of express electromagnetic phenomena through Maxwell equations in the frequency domain, taking into account the conditions and applications of static modeling of electromagnetic fields. Relationship of the electromagnetic phenomena and its modeling by electrical circuits is studied, understanding the constraints of this kind of model as well as the physical principles of the propagation and radiation phenomena and their telecommunication applications (radio frequency, microwaves and optic): Transmission lines, waveguides and antennas.	None	IELE 1006 - Fundamentals of Electrical Circuits, MATE 1207 - Vector Calculus, MATE 2210 - Complex Variable, FISI 1028 - Physics II	3
IELE	2009	Electrical and Electronic Engineering	Scientific Computing for Electrical and Electronic Engineering	The course begins with the basic concepts of numerical representation in computers, the error theory principles and the floating point arithmetic. Subsequently, it presents the numerical analysis tools, such as Linear and nonlinear equations, eigenvalue problems, differentiation and integration of one or two variables and partial differential equations. The methodology is oriented to present the scientific computing in the context of electrical and electronic engineering.	None	ISIS 1204 - Algorithmics and Object-Oriented Programming I, IELE 1502 - Dynamic Systems, MATE 2210 - Complex Variable	3
IELE	2010	Electrical and Electronic Engineering	Materials for Electrical and Electronic Engineering	The main focus of the course is to show the products applications from the point of view of science of materials. The course aims to give the students the tools to understand the interrelation between materials, properties, phenomena, process and synthesis. The course introduce technical standards for the handling of parameters, properties and effects of materials.	None	MATE 1214 - Integral Calculus and Differential Equations, FISI 1028 - Physics I	3
IELE	2040B	Electrical and Electronic Engineering	Science, Technology and Gender	This course aims to stand out the contribution of gender diversity in advancing innovation, science and engineering. A diversity that includes the active components that develop the latter: men, women, and others in frameworks of productivity, importance and performance for society. The course places the students on the impact of bias that even today maintains the distribution of different professional activities, its visibility, the acknowledgement, both material and academic, of those who have taken part on the greatest scientific/technological advances in Colombia. Statistics, roles, job profiles, professions, networks, security and specific examples.	None	None	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IELE	2042B	Electrical and Electronic Engineering	Technology of Ironman	The history of humanity has been tied to the relationship between technological developments, its connection with the individual and their impact on society. Recent technological developments, particularly in the design and electronics have revolutionized the way society perceives modern technology and generates applications and dependencies unthinkable years ago. The question is how, from different disciplines and perspectives, we can evaluate the impact of these technological developments on the technical, social and ethical. In this course we will study, through the technological advances of the controversial Ironman fictional character, the way individual, technology and society are amalgamated; and analyze how advanced technology impacts positively and negatively in technical, social and ethical aspects.	None	None	3
IELE	2100	Electrical and Electronic Engineering	Elements of Electrical Power Systems	This course aims to introduce the student the modeling techniques of the power system components and the system analysis techniques in steady state. The course presents the basic theory of the energy electro mechanic conversion, active and reactive power, single phase and three phase transformers, fundamentals of induction and synchronic electric machines. In addition, the course includes the presentation of the transmission lines fundamental concepts and modeling. Finally, there is an approach to the steady state analysis with the presentation of the per-unit system, load flow and short circuit.	None	IELE 1006 - Fundamentals of Electrical Circuits, FISI 1028 - Physics I	3
IELE	2202	Electrical and Electronic Engineering	Architecture of Digital Systems	Study of the hardware and software elements of a microprocessor-based system. Processor implementation at a logical level, its elements and their control through microprogramming. Study and design of a microprocessor and its modules through their description and validation using high-level techniques and technologies. Micro-programs, machine language, assembly language, high-level language. Supporting devices, microprocessor architectures, microcontrollers and advanced computer architectures, operating system characteristics, resources management. Structured design methodologies. ASIC (Application-Specific Integrated Circuit) technologies. Economic issues and design styles. Design tools.	None	None	3
IELE	2204	Electrical and Electronic Engineering	Fundamentals of Electronics	Main electronic fundamentals are included in this course, where the student will acquire basic knowledge of comprehension and analysis of circuits including electronic components, mainly diodes and transistors. Basic DC and AC configuration and modules will be analyzed. This course is complemented by laboratory sessions where the student reinforces key concepts and becomes familiar with the elements and devices treated theoretically.	None	None	3
IELE	2206	Electrical and Electronic Engineering	Fundamentals of Electronics	The course aim to give the students the skills to understand the operation, use and application of devices of 2 or 3 terminals: diodes and transistors. The course presents the fundamentals of semiconductor materials and electronic transport, in order to establish different configurations of semiconductors, insulators and conductors where the electron and hole flux are controlled. The AC and DC responses of the devices are analyzed with models of small and large signal.	None	IELE 1006- Fundamentals of Electrical Circuits, IELE 2010 - Materials for Electrical and Electronic Engineering	3
IELE	2210	Electrical and Electronic Engineering	Digital Electronic Systems	This course approaches the functional, structural and physical design of logic gates, RTL, modules and functions. The course is oriented to train the student as a designer of digital systems, encouraging the development and use of simulation and design tools. The course interacts with basic elements of digital electronics, going from high level tools to physical and electrical parts.	None	LENG 2999 - English Reading Requisite, MATE 1207 - Vector Calculus, MBI0 1100 - Cell Biology or QUIM 1103 - Chemistry. DERE 1300 - Constitution and Democracy, Spanish Requisite (LENG 1501 or LITE 1611), IELE 1400 - Fundamentals of Networks, IELE 2206 - Fundamentals of Electronics	3
IELE	2300	Electrical and Electronic Engineering	Control Systems Analysis	The course aims to develop the competence and comprehension in the analysis and design of control systems in continuous time. The course presents modeling and analysis principles of continuous dynamic systems, SISO Linear control systems and implementation of design on software.	None	LENG 2999 - English Reading Requisite, MATE 1207 - Vector Calculus, FISI 1028 - Physics I	3
IELE	2402	Electrical and Electronic Engineering	Communications	The course begins with the general definition of a communication system, and an identification and analysis of its parts. It continues with the analog modulation of continuous wave, such as AM, FM and PM. Then, there is an approach to digital modulation systems and they are compared in terms of power, complexity, error probability and interference. Finally, the telecommunications systems boundaries are established based on the noise.	None	IELE 2002 - Electromagnetic Theory, IELE 2500 - Signals, IIND 2106 - Probability and Statistics	3



Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IELE	2500	Electrical and Electronic Engineering	Signals	The course prepares the student to understand the mathematical bases of different topics, such as wavelet, time-frequency analysis, Hilbert transform, Volterra systems, modulation, etc. This course assumes familiarity and maturity with the mathematical topics like Complex Variable, Vector Calculus and Linear Algebra. The use of circuits encourages the student to put into practice the learned concepts, which may be abstract.	None	MATE 1207 - Vector Calculus	3
IELE	3006	Electrical and Electronic Engineering	Optimization	Optimization theory is presented as an intermediate mathematical level. Static and dynamic cases, including the basics of optimum control are shown, as well as Linear and nonlinear problems, for continuous variables, with few cases of discrete variables; and in general for deterministic cases. Design activities are proposed, aiming to the presentation of optimization problems, types of design, control and applications in various areas of electrical and electronic engineering.	None	LENG 2999 - English Reading Requisite, ISIS 1204 - Algorithmics and Object-Oriented Programming I, IIND 2106 - Probability and Statistics I, IELE 1006 - Fundamentals of Electrical Circuits, IELE 1400 - Fundamentals of Networks, IELE 2500 - Signals, MATE 1207 - Vector Calculus, IELE 2009 - Scientific Computing for EEE, DERE 1300 - Constitution and Democracy, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry	3
IELE	3100	Electrical and Electronic Engineering	High Voltage Transmission Lines and Electric Power Substations	The course presents the design bases of the principal components in the infrastructure of a power system: substations and transmission lines. The course is focused on the study of the design techniques of high voltage infrastructure. Hence, the students develop several design exercises.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, IELE 2500 - Signals, MBIO 1100 Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy	3
IELE	3102	Electrical and Electronic Engineering	Power Systems Analysis	The course presents advanced mathematical and computing techniques for the analysis of power systems. The power systems matrix form is presented for the steady state analysis, short circuit analysis and transient phenomena analysis. Also, the techniques of optimal power flow, radial power flow and stochastic power flow are studied. The course presents the general scheme of the frequency and voltage control in power systems.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, MATE 1207 - Vector Calculus, MBIO 1101 - Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy	3
IELE	3106	Electrical and Electronic Engineering	Power Systems Electronics	This course provides the analysis and design tools for energy conversion systems, based on electronic components and applied to control rotor speed, power sources in switch mode, connection of energy sources to the grid, reactive and harmonic compensation, UPS and FACTS devices, among others. The course pretends that the student applies the concept of power quality to obtain a criterion of power systems electronics applications.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, DERE 1300 - Constitution and Democracy, IELE 2500 - Signals, IELE 1400 - Fundamentals of Networks, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IELE	3108	Electrical and Electronic Engineering	Power Systems Workshop	The course develops a consultancy engineering project related to industrial power systems. The students develop a power quality study in order to identify the principal problems, causes and effects. The diagnostic is complemented with a detailed design to solve the problems. Finally, the students present the design of the expansion of a substation.	None	LENG 2999- English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, IELE 2009 - Scientific Computing for EEE, MATE 1207 - Vector Calculus, MBIO 1100 - Cell Biology or QUIM 1103- Chemistry, DERE 1300 - Constitution and Democracy	3
IELE	3110	Electrical and Electronic Engineering	Power Systems Economy	The course presents the basic economic concepts of the operation of markets, organization, competence, market imperfections and regulatory policies. Subsequently, the students will learn about the power systems economics, taking into account the electricity markets, ancillary services, efficiency, monopolies and rules of the market.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, MATE 1207 -: Vector Calculus, MBIO 1100 Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy, Spanish Requisite (LENG 1501 or LITE 1611),	3
IELE	3135	Electrical and Electronic Engineering	Automation of Distribution Systems	The course introduces the student of electrical and electronic engineering to the design and analysis techniques of distribution power systems. In addition, it presents application cases using normativity and computing tools.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, IELE 2500 - Signals, IELE 2009 - Scientific Computing for EEE, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy.	3
IELE	3138	Electrical and Electronic Engineering	Industrial Power Systems	The course introduces the student of electrical and electronic engineering to the design and analysis techniques of industrial power systems. In addition, it presents application cases using normativity and computing tools.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, IELE 2500 - Signals, IELE 2009 - Scientific Computing for EEE, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy	3

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IELE	3150	Electrical and Electronic Engineering	Renewable Energies	This course presents the different sources and technologies of renewable energies that have been integrating to the energy market on the last decades. The course reviews the actual context of the energy sources and the necessity of take advantage of renewable resources. The course presents the different technologies such as solar, wind, geothermic, biomass, hydric and oceans. Finally, there is an approach to the integration process of the renewable energies.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, MBIO 1100 -Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy	3
IELE	3152	Electrical and Electronic Engineering	Smart Grids	The course presents concepts related to smart grids, especially with the demand participation. There will be an approach to different topics, such as demand response, price programs, required technology, energy efficiency, barriers and requisites for the implementation of the programs. National and international experience will be reviewed, identifying the policies and current regulation.	None	LENG 2999 - English Reading Requisite, IELE 2100 - Elements of Electrical Power Systems, IELE 1400 - Fundamentals of Networks, IELE 2500 - Signals, IELE 2009 - Scientific Computing for EEE, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy.	3
IELE	3200	Electrical and Electronic Engineering	Analog Electronics	It's necessary to identify the circuital model of the transistors taking into account the frequency response in order to design and understand single or multistage amplifiers. The course presents the characteristics, stability and feedback effects in amplifier circuits. It's important to acquire the abilities to design an amplification circuit depending on the application.	None	LENG 2999 - English Reading Requisite, DERE 1300 - Constitution and Democracy, Spanish requisite (LENG 1501 or LITE 1611), MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry, IELE 2206 - Fundamentals of Electronics	3
IELE	3206	Electrical and Electronic Engineering	Electronic Instrumentation	None	None	LENG 2999 - English Reading Requisite, IELE 2206 - Fundamentals of Electronics, MBIO 1100 -Cell Biology or QUIM 1101 - Chemistry.	3
IELE	3208	Electrical and Electronic Engineering	Electronics Workshop	In this course, the students design and implement a project from a certain area, under the guidance of a professor that has the role of Project Director. The course members work on the same topic but in different modules. It's intended that the student work in team and develop abilities in management of projects.	None	IELE 3200 - Analog Electronics, IELE 3220 - Digital Electronic Systems, IELE 3222 - Architecture and Design of Digital Systems or IELE 3206 - Electronic Instrumentation, LENG 2999 - English Reading Requisite, IELE 2009 - Scientific Computing for EEE	3
IELE	3220	Electrical and Electronic Engineering	Digital Electronic Systems	This course approaches the functional, structural and physical design of logic gates, RTL, modules and functions. The course is oriented to train the student as a designer of digital systems, encouraging the development and use of simulation and design tools. The course interacts with basic elements of digital electronics, going from high level tools to physical and electrical parts.	None	None	3
IELE	3222	Electrical and Electronic Engineering	Architecture and Design of Digital Systems	This course approaches modern design techniques and technologies using hardware systems based on microprocessors. There are studied different levels of computer architectures such as logic, microprogramming, assemble and operative system.	None	IELE 3220 - Digital Electronic Systems, ISIS 1204 - Algorithmics and Object-Oriented Programming I	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IELE	3330	Electrical and Electronic Engineering	Control Workshop	In this course, the students design and implement a project from a certain area, under the guidance of a professor that has the role of Project Director. The group members work on the same topic but in different modules. It's intended that the student work in team and develop abilities in management of projects.	None	LENG 2999 - English Reading Requisite, IELE 2300 - Control Systems Analysis, IELE 1400 - Fundamentals of Networks, MATE 1207 - Vector Calculus, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy	3
IELE	3336	Electrical and Electronic Engineering	Industrial Automation	The quick evolution of the computer engineer, communications and technology of sensors have led to the proliferation of new industrial automation systems in production, manufacture, traffic control systems, distributed control systems, and others applications. This activity in this system runs by operative sequences designed by humans. This course focus in forming capable engineers for conceptualize and design devices, machines and systems for industrial automation.	None	LENG 2999 - English Reading Requisite, IELE 2300 - Control Systems Analysis, MATE 1207 - Vector Calculus, DERE 1300 - Constitution and Democracy, MBIO 1100 Cell Biology or QUIM 1103 - Chemistry.	3
IELE	3338	Electrical and Electronic Engineering	Robotics	This course proposes a practical project in the robotics area. The project should be addressed using the engineering practices and tools acquired along the bachelor program and properly applying all the topics learned through the semester.	None	LENG 2999- English Reading Requisite, IELE 2300 - Control Systems Analysis, MATE 1207 - Vector Calculus, DERE 1300 - Constitution and Democracy, MBIO 1100 -Cell Biology or QUIM 1103 - Chemistry.	3
IELE	3412	Electrical and Electronic Engineering	Wireless Communications Techniques	This course introduces to the problem of the radio network, with his planning and design. The course presents advanced digital transmission such as OFDM/A, SC-FDMA and MIMO. Also, it approaches to the concept of schedulers and LTE cellular network.	None	LENG 2999 - English Reading Requisite, IELE 2402 - Communications, IELE 1400 - Fundamentals of Networks, MATE 1207 - Vector Calculus, DERE 1300 - Constitution and Democracy, IELE 1006 - Fundamentals of Electrical Circuits, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry	3
IELE	3420	Electrical and Electronic Engineering	Tele-traffic Engineering	The communication network engineering requires the deep knowledge of fundamental principles of communications, the qualitative analysis of its structures and protocols and a group of models and tools that support the labors of design, planning, and evaluation of grid performance and new proposals of protocols and technology. The focus of this course is to integrate communication grids, simulation and probabilistic models with the purpose of deliver the basis to make the quantitative analysis of themselves.	None	ISIS 1204 - Algorithmics and Object-Oriented Programming, IELE 3400 - Communications	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IELE	3430	Electrical and Electronic Engineering	Communication Workshop	The course introduces modern tools for the holistic design of telecommunication projects, filling the requirements of this sector. The course allows the student to develop competences in identifying, formulating, analyzing and solving engineering problems.	None	LENG 2999 - English Reading Requisite, IELE 2402 - Communications, IELE 1006 - Fundamentals of Electrical Circuits, MBIO 1100 - Cell Biology or QUIM 1103 - Chemistry, DERE 1300 - Constitution and Democracy, IELE 1400 - Fundamentals of Networks, MATE 1207 - Vector Calculus	3
<b>Industrial Engineering</b>							
IIND	1000	Industrial Engineering	Introduction to Industrial Engineering	This course is the first actual contact between the student and the Industrial Engineering curriculum, along with all the possibilities that the Department and the University offer. Presents the different areas where Industrial Engineering graduated from Universidad de los Andes can contribute and develop their knowledge in Colombia and in the world. At the end of the course the students should be able to apply some of the tools, topics and contents of Industrial Engineering known and applied in a particular project (project EXPOANDES). Specifically, the course is proposed as an area of counseling and ongoing support for students in first semester to facilitate students' adjustment to their new role at university. Allows students to reinforce their decision about joining the Industrial Engineering program, or otherwise, provides the opportunity for responsible people who do not feel identified with the choice of life as an Industrial engineer to join one of the many programs offered by the Universidad de los Andes or other institutions. Finally it intends to show the university as an institution, interested in the development and training of the students as individuals.	None	None	3
IIND	2106	Industrial Engineering	Probability and Statistics I	This course is aimed at providing students with a sound preparation in Probability and Statistic basic concepts and their applications, in such a way that they will better understand and use non-deterministic models in the solution of real life problems that imply risk and uncertainty, as well as in statistic data management and analysis.	None	MATE 1105 - Linear Algebra I, MATE 1241 -Integral Calculus and Differential Equations.	3
IIND	2103	Industrial Engineering	Production Principles	The course covers mathematical modeling, the algorithmic ideas behind it and the mathematical properties of optimization models. It familiarizes the student with mathematical programming packages. The main subjects are: Linear optimizations problems and its geometrical characterization, improving search, Simplex Method, initialization algorithms e.g. two-phase method, Big M method; duality theory, sensitivity analysis and Linear problems with special structures like transport and transfer applications. Finally, a brief introduction to the Branch-and Bound Method, is presented.	FISI 1028 - Physics II	MATE 1105 - Linear Algebra I, ISIS 1204 - Algorithmics and Object-Oriented Programming I	3
IIND	2104	Industrial Engineering	Probabilistic Models	This course is intended to provide students with a sound preparation in stochastic processes basic concepts, and queuing and simulation theory, which enable them to better understand and use non-deterministic models in real problem formulation and solution. The course is divided in two parts: Discrete Time Stochastic Processes and Continuous Time Stochastic Processes.	None	IIND 2106 - Probability and Statistics I, FISI 1028 - Physics II	3
IIND	2107	Industrial Engineering	Probability and Statistics II	The course is focused on methods and statistics techniques. Parameter Estimation. Variability and standard error of estimators. Confidence interval, hypothesis testing, p- value. Analysis of Variance and experimental design. Linear Model and Regression analysis with emphasis in categorical variables and multicollinearity.	None	IIND 2106 - Probability and Statistics I	3
IIND	2201	Industrial Engineering	Production Planning and Control Systems	The course covers the basics of production planning and control operations. The main topics are: forecasting, aggregated planning, inventory systems and scheduling. The student should be able to identify, formulate and solve problems using the tools presented in the course. It is expected that after students have been exposed to current approaches they will be able to adapt them to real situations in manufacturing and service companies.	IIND 2106 - Probability and Statistics I.	IIND 2002 - Production Fundamentals, IIND 2103 - Optimization Principles.	3

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IIND	2202	Industrial Engineering	Basics of Production	This course focuses on introducing students to fundamental concepts and tools to analyze and improve operations in manufacturing and services industries. The main subjects include work study, plant design and process flow study in manufacturing operations. The student, at the end of the course, must be capable of analyzing processes and infrastructure elements of production systems in order to identify improving alternatives from its operations standpoint. Complementary to class sessions, students develop a team-work project in a production company to analyze a real environment and put in practice concepts and tools.	None	IIND 1000 - Introduction to Industrial Engineering (for IIND students) MATE 1203 - Differential calculus	3
IIND	2301	Industrial Engineering	System Dynamics	The course aims to introduce System Dynamics as a useful tool for analysis and understanding behavior of systems, particularly of social systems, in order to develop better skills in policy design. Course subjects include: introduction to systems thinking and dynamic complexity, basic concepts of system dynamics such as causal loop diagrams, stock and flow models, computer simulation tools, generic structures, evaluation of system dynamics projects and critical thinking.	None	IIND 2302 - Systemic Thinking in Organizations, IIND 2106 - Probability and Statistics I	3
IIND	2302	Industrial Engineering	Systemic Thinking in Organizations	The student should become familiar with the evolution of the concept of organizations so as to appreciate different dimensions to observe and to conceptualize such social systems. He should also be able to observe organizations from a systemic point of view; finally, he should be able to prepare a technical bibliography review report on an organizational topic.	None	None	3
IIND	2400	Industrial Engineering	Financial Statement Analysis	The main objective is to provide the student with basic management information system guidelines, from the financial standpoint, used in organizations for planning and decision-making purposes. The intention, of these guidelines, is to ensure understanding of the accurate decision-making process complexity on a real company. The main subjects of the course include financial statements development and analysis (balance sheet, profit and loss statement and cash flow), depreciation, adjustments by inflation, financial diagnosis, financial grounds and indicators, financial planning, budgets and Cost-Volume-Profit analysis.	None	Any Introduction to Engineering course	3
IIND	2401	Industrial Engineering	Investment Decision Analysis	The course covers evaluation of investment projects and capital budgeting alternatives. The different concepts introduced will allow the student to determine the financial viability and feasibility of an investment project. At the end of the course, the student must be able to understand the concept of time value of money, evaluate an investment project and calculate its net present value and its internal rate of return, evaluate a project under uncertainty and risk, as well as its sensitivity to the variables involved. Some of the course subjects include basic financial mathematics, selection among mutually exclusive alternatives, and construction of cash flows, among others.	Probability and Statistics or Probability and Statistics I	Any Introduction to Engineering course	3
IIND	3113	Industrial Engineering	Discrete Event Simulation	This course focuses in the development of models that represent systems that change through time (dynamic) and mostly whose states depend on random phenomena (stochastic). The main focus will be on simulation in discrete time and event driven. This has great application in Engineering and related areas for efficiency and versatility in modeling various types of systems, most of them inherently complex. Although the course focuses on discrete event simulation, it also includes elements of continuous simulation, and other topics relevant support in the fields of probability and statistics, data analysis, optimization, among others.	Probabilistic models	IIND 2106 - Probability and Statistics I	
IIND	3221	Industrial Engineering	Supply Chain Management	The logistics course includes different conceptual elements related to Supply Chain management. The basic components of the Supply Chain (customer service, transport management and inventory management) are analyzed from a systemic and integrator viewpoint. Students acquire Logistics Management skills, because they study the components and basic processes from an optimal management of suppliers, resources and customers' perspective. Emphasis is made on the fact that the use of new information and communication technologies allows strengthening the efficiency of Logistics processes in the organization. Process integration models are studied, such the SCOR model, and logistics processes are modeled through the use of mathematical models in the transportation, supply chain strategic design and inventory topics. The analysis methodology includes workshops where the logistics reality is analyzed by studying Colombian companies' cases. In such regard, students are stimulated to use previous knowledge acquired in inventory models, forecast techniques, cost analyses, transport models, optimization and simulation techniques, among other topics.	None	IIND 2201 - Production Planning and Control System, LENG 2299 - English Reading Requisite.	3
IIND	3311	Industrial Engineering	Organizational Strategy	The strategy course includes many concepts related to the development of a strategic plan in an organization. Throughout the course, basic components that make up strategy are thought (Mission, Vision, Delta Model, planning, Balance Score Cards and knowledge management among others). The main objective of the course is to create a context in which students use organizational strategic tools from a systemic perspective to develop the ability of the students to make strategic decisions. This is done through a simulation that lasts one semester in which students must make decisions every week.	None	IIND 2301 - Systems Dynamics, LENG 2299 - English Reading Requisite.	3

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IIND	3400	Industrial Engineering	Finance	This course is intended to provide conceptual framework and basic tools to analyze and understand the financial decision-making process in a corporation that operates within the framework of an efficient capitals market. The course content covers the different basic components of the investment and financing decisions financial theory within the context of a capitals market. Subjects include capitals market and efficiency lessons, share, risk and profitability valuation, investment decisions under uncertainty, capital structure and financing decisions, CAPM and the Modigliani & Miller propositions.	None	IIND 2401 - Investment Decision Analysis.	3
<b>Mechanical Engineering</b>							
IMEC	1000	Mechanical Engineering	Introduction to Mechanical Engineering	This course presents the student a general vision of the most important areas of Mechanical Engineering, as well as its impact in today's technological society. Topics covered include fundamentals of engineering design, materials engineering, manufacturing processes, energy conversion, design and construction of machines; everything from different points of view both empirical and analytical.	None	None	3
IMEC	1001	Mechanical Engineering	Fundamentals of Experimentation	This course trains students in the planning, conduction and socialization of experiments under within the context of the real engineering practice. Special focus is placed on the correct measurement of physical variables that are common in engineering. The course covers topics like: unit systems, measurement of basic physical variables, collection and analysis of data, etc.	None	None	3
IMEC	1410	Mechanical Engineering	Materials Science	Materials Science is a basic course that gives the student a conceptual framework to comprehend the behavior of engineering materials: metals, polymers, ceramics and composites. The course emphasizes on the relation between structure at diverse scales (nano, micro and macroscopic), with the physical and mechanical properties of the materials, to understand mechanical processes of forming, as well as modification of materials properties.	None	QUIM 1103 - Chemistry, IMEC 1000 - Introduction to Mechanical Engineering	3
IMEC	1503	Mechanical Engineering	Graphic Design in Engineering	This course deals with drawing as an engineering language and shows how it constitutes a powerful tool of design and communication. The course is based on projects that challenge and create the need in the student of transmitting his/her ideas through the use of contemporary techniques and tools of computer aided design (CAD).	None	None	3
IMEC	1330	Mechanical Engineering	Thermodynamics	Thermodynamics is the first course of a series of four mandatory courses in the area of Energy Conversion. This course focuses on the understanding of the first and second laws of thermodynamics for the analysis of basic macroscopic systems (closed and open) and their interaction with the surroundings. As such, emphasis will be given to the study of different energy forms and its transfer through the boundaries of a system as heat or work. Additionally, the properties of pure substances will be studied. The course will finish with the study of power cycles (Otto's cycle, Diesel cycle and Brayton's cycle).	None	IMEC 1000 - Introduction to Mechanical Engineering, MATE 1214 - Integral Calculus and Differential Equations	3
IMEC	1541	Mechanical Engineering	Rigid Body Mechanics	This is the first course of a series of three mandatory courses in the area of Mechanical Systems of the ME program. This course focuses on the basic concepts of mechanics applied to engineering (free-body diagram, Newton's laws, particles and solid bodies' equilibrium, friction, structures and trusses analysis, etc.).	None	FISI 1018 - Physics 1, IMEC 1000 - Introduction to Mechanical Engineering, MATE 1214 - Integral Calculus and Differential Equations	3
IMEC	2210	Mechanical Engineering	Fluid Mechanics	This is an introductory course that belongs to the basic sciences of engineering. It is focused on the study of the most important physical properties of fluids and the basic mathematical models that allow to describe, analyze and control their behavior, in common static and dynamical conditions. The course is essentially theoretical, although some applications are treated. Experimental and practical aspects of engineering practice related to fluid mechanics are also discussed.	None	MATE 1207 - Vector Calculus, FISI 1028 - Physics 2, IMEC 1330 - Thermodynamics	3
IMEC	2320	Mechanical Engineering	Heat Transfer	In this course, the basic heat transfer mechanisms are studied: conduction, convection and radiation. In conduction, steady-state and transient situations are considered. Analytical, numerical and graphical methods are used. The study of convection includes boundary layers, laminar and turbulent flows, as well as forced, free and mixed conditions, for both internal and external flows. The discussion of radiation comprises ideal and real emitters of thermal radiation, and the radiant exchange between opaque surfaces.	None	IMEC 2210 - Fluid Mechanics, MATE 2301 - Differential Equations	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IMEC	2411	Mechanical Engineering	Materials Engineering	Having learned the properties and basic applications of the main material families, this course seeks to introduce the student into the world of structures control in its most relevant scales. This approach allows giving more precision to the selection criteria for the design of processes and products, taking into account the internal structure of the material. It is also desired that the knowledge acquired is contextualized with the national technological reality and that it is used to motivate innovation. The objective of the course will be achieved through the study of the different families of materials, particularly metals, ceramics and polymers. This study will be carried out with the following sequence: i. Generalities-introduction, ii. Structures, iii. Properties, iv. Manipulation-volumetric and superficial properties, v. Composites from this material family. The execution of projects will be the application center and contextualization of the gained knowledge.	None	IMEC 1001 - Fundamentals of Experimentation, IMEC 1410 - Materials Science	3
IMEC	2520	Mechanical Engineering	Deformable Body Mechanics	The main purpose of this course is to provide the fundamentals of structural design from a unified treatment of applied mechanics. The constant demand of machine structures and components ever more sophisticated, require the engineer to have a clear understanding of the stress and strain components, and of material properties. From this, the course must deliver the student the ideas and information necessary to understand the basic concepts of deformable body mechanics and, with this, give impulse to the creative process for design.	None	FISI 1018 - Physics 1, IMEC 1000 - Introduction to Mechanical Engineering, MATE 1214 -Integral Calculus and Differential Equations	3
IMEC	2540	Mechanical Engineering	Dynamics of Mechanical Systems	Dynamics of mechanical systems is the second class out of three mandatory classes in the area of Mechanical Systems within the ME program. In particular, this class is based on the studying of the behavior related to rigid body motion under the action of forces. Basic concepts of rigid body dynamics in two dimensions are introduced. The main objective is to understand the dynamical behavior of systems, how can this be computed, and how similar dynamical laws can be applied to other domains.	None	MATE 1105 - Linear Algebra I, IMEC 1541 - Rigid Body Mechanics, FISI 1018 - Physics 1	3
IMEC	2543	Mechanical Engineering	Machinery Dynamics	This course approaches the analysis and synthesis of mechanisms and machines, from the motion point of view. In the course, the associated forces and required power for the operation of those machines are estimated, while at the same time analyzing the power transmission elements used to move them.	None	IMEC 2540 - Dynamics of Mechanical Systems	3
IMEC	2700	Mechanical Engineering	Intermediate Project	Intermediate project is the second course of the program's project sequence, constituted additionally by the courses Introduction to Mechanical Engineering and Degree Project. The main objective of the course is the formal development of a ME project, through the application of specific tools of this discipline. This project will invariably have the following elements: The exploration of the context in which a project is carried out (local industrial environment, as well as social, legal, economic and environmental aspects, among others). This course promotes: learning and feedback from peers, contextualized application of concepts, models and techniques learned during the first half of the program, and preparation of project results (reports, oral presentations, etc.).	None	IMEC 1330 - Thermodynamics, IMEC 2411 - Materials Engineering, IMEC 2520 - Deformable Body Mechanics, IMEC 2540 - Dynamics of Mechanical Systems, ISIS 1204 - Algorithmics and Object-Oriented Programming I, IELE 1002 - Fundamentals of Electrical Circuits	3
IMEC	3345	Mechanical Engineering	Energy Conversion Systems	The main objective of this course is to give the student an integral vision of the industrial systems and equipment of energy conversion (be it for supply or consumption), and to make us of the basic principles of engineering to analyze the behavior of those systems and equipment. The course is oriented toward the development of knowledge that allow the analysis, design and selection of energy conversion equipment that are frequently used in industry.	None	IMEC 2320 - Heat Transfer, IMEC 2700 - Intermediate Project, IIND 2106 - Probability and Statistics I, IIND 2401 - Analysis of Investment Decision, IELE 2300 - Analysis of Control Systems	3
IMEC	3460	Mechanical Engineering	Manufacturing Systems	The course deals with topics related to the manufacturing of industry's secondary sector products. Emphasis will be given to the fundamental principles of manufacturing processes. Required technologies for the transformation of materials into products will be presents, with a generic focus constituted by the following questions: what systems are there?, what are their specifications?, and what are the functional elements of the system in a manufacturing facility. The students will develop skills to estimate flow of materials, energy and time, as well as the costs of required personnel for the fabrication of elements and products; basic tools to compete in the market. Coursework includes workshops and a project that demands organization and execution of administrative tasks, along with teamwork management.	None	IMEC 2411 - Materials Engineering, IMEC 2700 - Intermediate Project, IIND 2106 - Probability and Statistics I, IIND 2401 - Analysis of Investment Decision, IELE 2300 - Analysis of Control Systems	3



Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IMEC	3530	Mechanical Engineering	Design of Mechanical Systems	The purpose of this course is to expose students to problematic situations that simulate, with some limitations, the conditions in which mechanical systems are designed during the professional practice. That is, situations that must be solved from the best possible information that can be collected, and within a determined timeframe and available budget. In this course, the projects are developed in work teams, which is common in professional working environments.	None	IMEC 2543 - Machinery Dynamics, MATE 2301 - Differential Equations, IMEC 2700 - Intermediate Project, IIND 2106 - Probability and Statistics I, IIND 2401 - Analysis of Investment Decision, IELE 2300 - Analysis of Control Systems	3
IMEC	3700	Mechanical Engineering	Graduation Project Seminar	This seminar aims at two main objectives. The first one is to instruct students that are close to undertaking their graduation project, in some aspects of practical nature for its successful development. The second one is to introduce students to topics related to their future professional life, the regulation of the ME profession in Colombia, their possibilities of professional development, entrepreneurship, the profession development trends, engineering ethics, etc.	None	IMEC 2700 - Intermediate Project, IIND 2106 - Probability and Statistics I, IIND 2401 - Analysis of Investment Decision	0
IMEC	3701	Mechanical Engineering	Graduation Project	The graduation project is an individual project, developed by last year students, that consists of the study of concrete problems of an application area of Mechanical Engineering, and is developed under the direction of an advisor professor (supervisor). The project can have diverse emphasis that can include design and construction, modeling and simulation, or experimental validation of models. As a conclusion, the student submits a final report that is included in the collection of the University's Library System.	None	IMEC 3700 - Graduation Project Seminar, IMEC 3530 - Design of Mechanical Systems, IMEC 3345 - Energy Conversion Systems, IMEC 3460 - Manufacturing Systems, IIND 2401 - Analysis of Investment Decision, IELE 2300 - Analysis of Control Systems	3
<b>Chemical Engineering</b>							
IQUI	1001	Chemical Engineering	Introduction to Chemical Engineering	This course, Introduction to Chemical Engineering, seeks to teach first semester students how to identify, explain and put into practice basic concepts of Chemical Engineering and concepts common to all Engineering programs. Students must distinguish between Chemical Engineering and other Engineering branches. Students must develop basic skills in communication, teamwork and assessment. The course seeks to have students identify, interpret, fulfill and recognize their rights and responsibilities as students of the Universidad de los Andes. Students must identify services offered by the university and use them properly.	None	None	3
IQUI	2010	Chemical Engineering	Fundamentals of Chemical Processes	This is a basic course of Chemical Engineering. The Fundamental of Chemical Processes prepares the students to formulate and resolve mass and energy balances in systems of chemical processes. This course is a complement to the course Introduction to Chemical and Thermodynamics Engineering and provides the fundamentals for other courses: Reaction Engineering, Unit Operations, Control and Process Design and Optimization. The course teaches how to establish relations between mass and energy equations, unknown process variables and available relations. The student must relate all the information to find the value of the unknown variables by properly calculation procedures and/or available computational methods.	None	None	3
IQUI	2020	Chemical Engineering	Thermodynamics	This is a fundamental course of Engineering. The course intends to make students understand the laws of Thermodynamics applied to pure substances as well as to establish bonds between Thermodynamics, other chemical phenomena and all sciences that are part of Chemical Engineering fundamentals.	None	MATE 1203 - Differential Calculus	3
IQUI	2021	Chemical Engineering	Chemical and Phase Equilibrium	The course seeks to apply thermodynamic concepts and fundamentals of mathematics. This concepts and fundamentals are basic for describing a system that reaches phase equilibrium or chemical equilibrium. This knowledge is the base for future courses being able to integrate kinetic aspects and mass transfer in order to design separation units and chemical reactors.	None	IQUI 2020 - Thermodynamics	3

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IQUI	2090	Chemical Engineering	Mid-career Project	This course provides students with opportunities to integrate knowledge, skills and basic attitudes in order to correctly complete a task, an action or an intellectual process according to their professional area. Students must act in a defined context of teamwork.	None	IQUI 2102 - Transport Phenomena II, IQUI 2200 - Design of Experiments	3
IQUI	2101	Chemical Engineering	Transport Phenomena I	Momentum transfer, heat and mass are phenomena ruling a lot of chemical processes. They also save strong physics and mathematical analogies. From the basic sciences students will understand importance of the momentum transfer phenomenon and its applicability to Chemical Engineering.	None	MATE 1207 - Vector Calculus	3
IQUI	2102	Chemical Engineering	Transport Phenomena II	This course introduces phenomena associated to mass and energy transfer in steady and unsteady state systems. This course introduces in the products and processes in chemical engineering using heat and mass transfer principles.	None	IQUI 2101 - Transport Phenomena I, IQUI 2020 - Thermodynamics	3
IQUI	2200	Chemical Engineering	Experimental Design in Chemical Engineering	This course shows the importance of experimental design and experimental data analysis. The course provides the fundamentals and concepts of experimental designs such as: basic experimental design (univariate and factorial), fundamentals of blocking, error reduction and development of basic regression models.	None	IIND 2106 - Probability and Statistics I	3
IQUI	2300	Chemical Engineering	Chemical Reaction Engineering	Chemical kinetics and reactor design constitute one of the key components for the synthesis of most chemicals. It is the knowledge of reaction engineering aspects what distinguishes chemical engineering from other engineering programs. The principles, methods and techniques learned in this class provide the student with basic elements and tools to solve a significant number of problems. Such applications cover a wide range of areas including petrochemical, pharmaceutical, agrochemical, bio-processes, environmental remediation, microelectronics, nanotechnology and living systems, among others	None	IQUI 2010 - Fundamentals of Chemical Processes, IQUI 2021 - Chemical and Phase Equilibrium.	3
IQUI	3001	Chemical Engineering	Separation Processes	Separation processes in mixtures are essential in chemical, petroleum, food, biochemistry and pharmaceutical industries. In this course students will use fundamentals of phase equilibrium, transport phenomena and Thermodynamics in order to distinguish separation processes using graphic and analytic methods. By using this knowledge, students will develop skills to select useful equipment for these processes.	None	IQUI 2021 - Chemical and Phases Equilibrium, QUIM 1618 -Fundamentals of Chemical Analysis, IQUI 2102 - Transport Phenomena II, LENG 2999 - English Reading Requisite	3
IQUI	3010	Chemical Engineering	Unit Operations	Unit operations are each one of the actions required in an industrial process in order to transform, adapt or transport materials. They can be considered as design procedures common to industrial processes, which are frequently applied in the field of Chemical Engineering. The students should learn how to design, size, and select different industrial equipment, based on their knowledge of transport phenomena and the fundamentals of industrial processes, which they have learned in previous courses. The course focuses on: the storage and transport of fluids and solids, and the industrial processes for heat exchanging.	None	FISI 1028 - Physics II, IQUI 2102 - Transport Phenomena II, LENG 2999 - English Reading Requisite.	3
IQUI	3031	Chemical Engineering	Process Plant Design	This course, Process Plan Design, introduces students to techniques and methods related to process and product design. Students should recognize development elements in a process. Students should apply different courses learned in their Chemical Engineering major. They must complement this knowledge by developing simulation work and process calculation. Students must establish solutions to specific problems.	None	IQUI 2300 - Reaction Engineering, IQUI 3010 - Unit operations, IQUI 3001 - Separation processes, IIND 2401 Investment Decision Analysis, LENG 2999 -English Reading Requisite	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
IQUI	3039	Chemical Engineering	Introduction to Modeling and Simulation	This course seeks to provide mathematical and computational tools to represent phenomena typical of Chemical Engineering. An important part of the work done by an engineer is on solving problems from basic principles of nature. These problems are generally difficult to define because of its complexity. Modeling is a tool used to express reality, so that the constituent parts are related in terms that are understandable to the engineer. There are several types of models, depending on the scale at which you want to look at reality, starting from a very basic representation of electronic interactions, to a macroscopic view. The modeling system behavior can be predicted by using another powerful tool: simulation	None	ISIS 1204 - Algorithmics and Object-Oriented Programming I, IQUI 2102 - Transport Phenomena II, IQUI 2300 - Chemical Reaction Engineering, LENG 2999 - English Reading Requisite, QUIM 1618 - Fundamentals of Chemical Analysis, MBI0 1100 - Cell Biology, FIS1 1028 - Physics II, FIS1 1029 - Experimental Physics II	3
IQUI	3040	Chemical Engineering	Optimization of Chemical Processes	This course introduces concepts of optimization, specifically process optimization with applications in the chemical industry. By the end of the course students will recognize application areas of numerical optimization. Students will be able to formulate and solve optimization problems, applying the main algorithms and some commercial tools in order to solve these kinds of problems	Separation Processes (IQUI 3001).	ISIS 1204 - Algorithmics and Object-Oriented Programming I, IQUI 2300 - Chemical Reaction Engineering, LENG 2999 - English Reading Requisite	3
IQUI	3090	Chemical Engineering	Undergraduate Project Seminar	The purpose of this course is to have students prepare a research project on a topic of interest applying scientific research methods. We expect that the project completed during this course will help each student with graduation project. Students present this graduation project to meet basic requirements in order to obtain their chemical engineering degree	None	IQUI 2300 - Chemical Reaction Engineering, IQUI 2102 - Transport Phenomena II, MBI0 1100 - Cell Biology, LENG 2999 - English Reading Requisite.	3
IQUI	3091	Chemical Engineering	Undergraduate Graduation Project	This course develops and evaluates last-semester student abilities to confront a problem autonomously while using methods and procedures for solutions in Engineering. It is expected that the students can integrate previously acquired competencies and knowledge in different areas of the learning process while developing their Graduation Project.	None	IQUI 3090 - Graduation Project Seminar, IQUI 2200 - Experimental Design in Chemical Engineering, IQUI 3001 - Separation processes, IQUI 3039 - Introduction to Modeling and Simulation, IIND 2401 Investment Analysis Decision, IQUI 2090 - Mid-Career Project	3
<b>Systems and Computing Engineering</b>							
ISIS	1001	Systems and Computing Engineering	Introduction to SCE	This course seeks to develop in participants a sense of belonging to the career, institution and program, as well as to encourage contact with business life by taking advantage of opportunities provided by different sources of information and interaction with other students, teachers and professionals in the area. Additionally, it aims to develop individual and group capacity to self-manage the learning process: to carry out processes and learning projects, taking into account the typical constraints of university life. Finally, it also aims to train participants in some of the basics of Systems and Computing Engineering and report on some of the career advanced areas.	ISIS-1002: SCE Mentoring	None	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
ISIS	1002	Systems and Computing Engineering	SCE Mentoring	It is the first department accompanying course which gives students different opportunities they can exploit during their career such as Uniandes Information, DISC Information, Regulations and SEC Curriculum.	ISIS-1001: Introduction to SCE	None	0
ISIS	1104	Systems and Computing Engineering	Discrete Mathematics and Logic	This course teaches the fundamental math concepts needed for Systems and Computing Engineering. It provides a language that allows for the formal definition of models, reasoning over these models as well as understanding and carrying out proofs using this formal language. Specifically this course teaches the syntax and semantics of discrete math models such as sets, relations, functions, propositional and predicate logic and number theory. Proof techniques applied to these models are also taught	None	ISIS 1204 - Algorithmics and Object-Oriented Programming I	3
ISIS	1105	Systems and Computing Engineering	Algorithms Design and Analysis	Basic concepts of algorithms design and analysis. At the end of the course the student should be able to apply developing techniques like divide and conquer, dynamic programming, and general search algorithmic, analyzing temporal and spatial complexity. Practical limitations for algorithmic solutions (e.g. NP-completeness) are studied at an introductory level.	None	ISIS 1104 - Discrete Mathematics and Logic	3
ISIS	1106	Systems and Computing Engineering	Languages and Machines	This course presents the basic concepts of language theory through formalisms used to describe them (grammars) and the machines used to recognize them (automatons). We also show how these machines can be used in other domains. We also present other formalisms (Petri Nets), their definition implementation and fields of application.	None	ISIS 1104 - Discrete Mathematics and Logic, ISIS 1205 - Algorithmics and Object-Oriented Programming II	3
ISIS	1204	Systems and Computing Engineering	Algorithmics and Object-Oriented Programming I	It is expected from this course that students acquire the relevant skills, knowledge and techniques to solve a problem, following a mental process. Such problems are in the context of an abstraction of a simple reality and they are described in terms of a computer program.	None	None	3
ISIS	1205	Systems and Computing Engineering	Algorithmics and Object-Oriented Programming ii	The purpose of this course is to continue the subjects achieved during the first course. Moreover, there will be new skills and knowledge necessary to handle the challenges. Particularly, students will face different elements to model entities of a more elaborated conceptual abstraction and will be presented with techniques to implement and solve algorithms of a more challenging level.	None	ISIS 1204 - Algorithmics and Object-Oriented Programming I	3
ISIS	1206	Systems and Computing Engineering	Data Structures	The purpose of this course is to generate the necessary skills to design and implement the required data structures to solve a problem entirely in main memory. The student must achieve solutions considering a set of restrictions and quality attributes proposed.	None	ISIS 1205 - Algorithmics and Object-Oriented Programming II	3
ISIS	1304	Systems and Computing Engineering	Foundations of Technological Infrastructure	Study the basic computer architecture, its components, description, function, and interaction among them. The student gets the basic language, concepts and tools to analyze computer infrastructure in terms of performance and liability. Case study: Intel Architecture for 32 bits (IA32).	None	ISIS 1205 - Algorithmics and Object-Oriented Programming II	3
ISIS	1404	Systems and Computing Engineering	IT in Organizations	This course presents different types of arranging an organization (enterprise, social group, formal or informal organization, that may be an IT provider or consumer organization) making emphasis on IT as fundamental element to articulate organization with its environment and to guide the organization to achieve its objectives. Main organizational and IT concepts–organizational structure and culture, business processes and value chain, information and information technology, IT governance frameworks and business alignment - and their relationships are studied to lead and to achieve organization objectives.	None	ISIS 1204 - Algorithmics and Object-Oriented Programming I	3
ISIS	2007	Systems and Computing Engineering	Product Design and IT Innovation	This course is located on the training and innovation projects line of engineering programs at the Universidad de los Andes. After the first semester experience in development projects with EXPOANDES, for a semester students will work on the definition and development of innovative projects with information technology. These projects have the ambition to be sustainable over time and internationally competitive. This dynamic must be reinforced with the knowledge and skills acquired in the second half of the engineering education. The activities of the students in the graduation project, which has a vocation of synthesis, can be a success factor for some of these projects started in this course, so they might be able to find a space in the business world and/or academic.	ISIS 2008 - Systems and Computing Engineering Vision	ISIS 2603 - Team Software Development	3
ISIS	2008	Systems and Computing Engineering	Systems and Computing Engineering Vision	It is the third department accompanying course which holds lectures with alumni and faculty to get closer to their research knowledge and professional profiles.	ISIS 2007 - Product Design and IT Innovation	ISIS 1002 - SCE Mentoring	3

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ISIS	2203	Systems and Computing Engineering	Computational Infrastructure	The goal of this course is to study the more important aspects that must be considered for choosing and maintaining the computational infrastructure for supporting the activities of a project or enterprise. The main problems that are considered are: capacity planning, transactions security, performance evaluation and servers securing. Additionally, other topics related to the above mentioned problems are studied: concurrency, deadlocks, asynchronous programming, virtual memory, file systems, machine states, memory protection and virtual machines.	None	ISIS 1304 - Foundations of Technological Infrastructure	3
ISIS	2304	Systems and Computing Engineering	Transactional Systems	This course studies the persistence problem of huge amounts of shared data in transactional systems.	None	ISIS 1206 - Data Structures	3
ISIS	2403	Systems and Computing Engineering	Enterprise Architecture	Study the way of understanding a complex organizational structure in order to design a high level IT architecture that allows supporting business objects the best way possible. Such design must specify a project roadmap that allows the organization to move forward from its actual situation, or AS-IS, to the objective situation, or TO-BE. Each project must group a set of requirements	None	ISIS 1404 -IT in Organizations	3
ISIS	2503	Systems and Computing Engineering	Software Architecture and Design	To develop software design and software architecture abilities based on shared experienced of academic researchers and industrial practitioners documented as styles, patterns and tactics. Also the student will understand the impact of the technology chosen in the software architecture.	None	ISIS 2603 - Team Software Development	3
ISIS	2603	Systems and Computing Engineering	Team Software Development	The purpose of the course for the student is to acquire practical experience through the development of a medium-sized project in groups of five students. For this, we use an iterative delivery process by stages, supported by computational tools.	ISIS-2304: Transactional Systems	ISIS 1206 - Data Structures	3
ISIS	3007	Systems and Computing Engineering	Final Project	The student is actively involved in designing and implementing an ICT solution that adds value and emphasize the dynamics of projects to integrate skills of teamwork and communication.	ISIS-3990: Enrollment & Degree Verification	ISIS 2403 - Enterprise Architecture	3
ISIS	3204	Systems and Computing Engineering	Communications Infrastructure	This is a first course of computer networks. Under a top-down approach, it presents each one of the levels that compose the protocol stack of a network, with special emphasis in TCP/IP that is in the base of the Internet. TCP/IP is used like example of real implementation of the fundamental concepts of networks, without forgetting the protocols and implementations of different network architectures. Specificities are additionally introduced to understand how to adapt these concepts to new technologies like wireless networks. Special emphasis is put to understand the impact on both security and performance of current networking implementations. The course has two equally important components: theoretical lectures and practical laboratories. Laboratories not only illustrate the practical part of the most important concepts seen in the theoretical classes, but also they complement in themes that seek to give to students new skills useful in the practice of the profession.	None	ISIS 1304 - Foundations of Technological Infrastructure, ISIS 2403 - Enterprise Architecture	3
ISIS	3301	Systems and Computing Engineering	Business Intelligence	The course objective is to study different scenarios in the decision making process within organizations. The required analysis, integration strategies, data structures, methodologies, technologies and support tools are also studied. For more information.	None	ISIS 2304 - Transactional Systems, ISIS 2403 - Enterprise Architecture	3
ISIS	3302	Systems and Computing Engineering	Modeling, Simulation and Optimization	The course provides students with tools and skills needed to build, define, validate and improve models for solving complex problems with computer technology. This will allow you to perform complete process from the interaction with an expert domain have a problem, until presented with a solution in a way he can understand, evaluate v and apply.	None	ISIS 1206 - Data structures, ISIS 1106 - Languages and Machines, IIND 2106 - Probability and Statistics I	3
ISIS	3425	Systems and Computing Engineering	Enterprise Systems	The course initiates with an overview of standard enterprise information systems for administrative support (General Ledger, Payroll, Inventory, Invoicing, etc.), as well as some typical business processes (order-to-cash, procurement-to-pay, etc.). Then, some important concepts are studied to acquire a good understanding of Enterprise's Vision, Mission, Strategy, Value chain, Competitive forces, etc., which serve as framework to conceive and justify useful projects of Enterprise information systems. A practical project is developed with an ERP system. Finally, principles of change management are introduced, to deal with the deployment of Enterprise Information Systems.	None	ISIS 2403 - Enterprise Architecture	3
ISIS	3510	Systems and Computing Engineering	Mobile Applications Development	The objective of this course is to generate in the student the skills necessary to design and build solutions in mobile devices, using a specific software development process. Students deal with heterogeneity in development and deployment. Here is understood by non-conventional, when there are restrictions in one or more of the following dimensions of execution environments: hardware, real time, storage, processing, power, weight, interfaces, visualization and communication.	None	ISIS 2503 - Software Architecture and Design, ISIS 3204 - Communications Infrastructure	3

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ISIS	3710	Systems and Computing Engineering	WEB Applications Development	Recognize and explain the main milestones in the evolution of web development. List and explain the main factors that have generated the major changes in web application development technologies. Explain the HTTP protocol from the perspective of web development: develop a basic protocol client and server. Develop applications using different technologies and development models that exist for web applications: stateless and stateless servers, static clients, dynamic clients. Developing asynchronous web applications using ajax. Develop restful applications in JavaScript using Angular as a framework.	None	ISIS 2503 - Software Architecture and Design	3
ISIS	3990	Systems and Computing Engineering	Undergraduate Degree - Enrollment	It is the last department accompanying course which performs activities related to ethical reasoning. Likewise, students can review administrative process to graduate.		ISIS 2008 - Systems and Computing Engineering Vision	0
<b>Math and Science</b>							
BIOL	1327	Biological Sciences	Ecology, Principles and Applications	The course —Ecology, principles and applications- has been designed with the aim to introduce the students, from disciplines other than the biological sciences, to the comprehension of ecological phenomena through the study of the interaction of organisms between themselves and with their environment. The course explores the way in which ecological and evolutive processes define the world we live in, starting with organisms as the fundamental unit of ecology and exploring the physical environment's role in life requirements. Later in the course, the ecological systems and the processes involved are studied, by evaluating populations, communities and ecosystems as units of natural election, evolution and biodiversity. The course concludes with the ecosystems in Colombia, natural parks, sustainability and conservation, oriented to the understanding of the impact that human activity produces in the environment through the application of the knowledge acquired during the course.	None	None	3
MBIO	1100	Biological Sciences	Cell Biology	This is a theoretical and practical course to help students understand the fundamentals and basics of cellular systems organization and cellular processes. These topics will be enshrined in the new tendencies of modern biology. This context will allow students to explore cellular structure and biomolecules. The course will cover typical processes such as energy flow, transport across cell membranes and intracellular transport. Students will also study signal transduction, cell signaling, cell division and metabolism. This material will be covered within the evolutionary and historical process of cellular biology, with an emphasis on molecular biology and its applications in biotechnology.	None	None	3
MBIO	2102	Biological Sciences	Molecular Biology	This course presents the basic aspects related to the relevant concepts and principles of Molecular Biology and includes an approach to the methods and tools used in this area. In addition, students understand how to formulate solutions to biological, biotechnological and biomedical problems.	MBIO 2103 - Molecular Biology Laboratory	QUIM 1103 - Chemistry	3
MBIO	2103	Biological Sciences	Molecular Biology Laboratory	The laboratory of Molecular Biology is focused on the learning, assembly and recognition of some of the molecular techniques seen in the theoretical class. This course is both practical and theoretical support, as it reinforces the concepts seen through experiments, short lectures, workshops, laboratory reports and scientific articles.	MBIO 2102 - Molecular Biology	QUIM 1103 - Chemistry	1
MBIO	2100	Biological Sciences	Biochemistry	Biochemistry comprises the entire molecular basis of the processes that are generated in living beings. This course allows students to understand the rules of the molecular logic of cells, recognize the structural basis of biomolecules, enzymatic catalysis and its relationship with bioenergetics. Finally, the students understand the central metabolic pathways, bringing the concept to a metabolic integration, focused on the interrelation of processes of degradation and synthesis that constitute Biochemical routes. The laboratory complements the contents seen in the theory and allows to familiarize the student with the fundamentals.	MBIO 2101 - Biochemistry Laboratory	QUIM 1301 - Organic Chemistry	3
MBIO	2101	Biological Sciences	Biochemistry Laboratory	This course teaches common methodologies to quantify biomolecules such as proteins, carbohydrates, lipids and enzymatic activity by colorimetric (quantitative) and electrophoresis (qualitative) methods.	MBIO 2100 - Biochemistry	QUIM 1301 - Organic Chemistry	1

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FISI	1018	Physics	Physics I	The aim of the course is to help the student develop a critical attitude towards the solution of scientific and practical problems. The student will be introduced to the scientific method through the study of the laws of mechanics, including kinematics in one and two dimensions, Newton's laws, conservation laws, rotational motion, gravitation and harmonic motion, at a level suitable for beginning undergraduates. The experiments performed during the semester will help the student to better understand the concepts in mechanics acquired in the theory class and to relate real physical phenomena with the models used to describe them.	None	MATE 1203 - Differential Calculus	3
FISI	1028	Physics	Physics II	The aim of the course is to help the student to further develop his/her understanding of the scientific method and hence to develop a critical attitude. This is achieved through the study of the basic laws of thermodynamics and electromagnetism and their applications to situations of actual physical interest.	MATE 1214 - Integral Calculus, MATE 1105 - Linear Algebra I	FISI 1018 - Physics I, MATE 1203 - Differential Calculus	3
FISI	1019	Physics	Physics I Laboratory	The objective of this course is to strengthen the connection between theory and practice by helping students to understand the theory studied in the Physics I course. This course aims to teach the rigor and honesty essential to the experimental work. In addition, the course presents and approach to some measuring instruments and intends to develop in students abilities for data analysis.	FISI 1018 - Physics I	None	1
FISI	1029	Physics	Physics II Laboratory	The objective of this course is to strengthen the connection between theory and practice by helping students to understand the theory studied in the Physics II course. This course aims to teach the rigor and honesty essential to the experimental work. In addition, the course presents and approach to some measuring instruments and intends to develop in students abilities for data analysis.	FISI 1028 - Physics II	None	1
MATE	1203	Mathematics	Differential Calculus	The modeling of instantaneous phenomena is very important in the study of Natural and Social sciences. The description of instantaneous phenomena is engulfed in the notion of limit, and it is through its celebrated offspring, the derivative and the integral of a function, that it finds its main applications. This course provides an introduction to the modeling of instantaneous phenomena, mainly those concerned with rates of change, i.e., the study of limits and of derivatives. As it ends up being unavoidable, and being so intimately related to the concept of differentiation, a short introduction on the subject of integration is also given in this course. This course is a first step towards making students aware of the power of the language of Mathematics when used as a tool for describing and analyzing natural and man-made processes	None	Math placement exam	3
MATE	1207	Mathematics	Vector Calculus	The aim of this course is to provide the student with the basic tools of multidimensional calculus and to give a framework to hone his/her abilities at modeling and solving problems that require a basic knowledge of the geometry of 2 and 3 dimensional space. Also, it is of particular interest in this course to enhance the relation between the language provided by Mathematics and physical phenomena, through the study of the three Fundamental Theorems of Vector Calculus, namely, Green's, Stokes' and Gauss' Theorem.	None	MATE 1214 - integral Calculus and Differential Equations, and MATE 1105 - Linear Algebra I.	3
MATE	1214	Mathematics	Integral Calculus and Differential Equations	This course is in part a continuation of the study of one-dimensional Calculus: one of the main concepts introduced in this course is that of integration. Here the student enlarges his/her toolkit to model instantaneous phenomena by the use of integration techniques. On the other hand, an Introduction to the theory of Linear differential equations is also given: differential equations are the butter and bread of scientists and engineers, and, without any hint of doubt, they enormously expand the realm of possible applications of Calculus. Finally, as a first encounter with infinity and its paradoxical properties, series is a topic of study covered in this course; and again, as we want students to notice that mathematical concepts are not that far from real world applications, the study of series and its convergence properties derives in the study of Taylor series.	None	MATE 1203 - Differential Calculus.	3
MATE	1105	Mathematics	Linear Algebra 1	The Linear Algebra course serves two purposes: give students the basic tools of the subject, used in all sciences and the different branches of engineering; and present these tools in a mathematically rigorous way. In particular, mathematical proofs will be demanded from students in the assessments.	None	MATE 1203 - Differential Calculus	3
MATE	2301	Mathematics	Differential Equations	Differential equations constitute the natural objective of elemental calculus and the most important mathematical area for the understanding of the physical sciences. Power series, Fourier series, integral equations, existence theorems; all these topics appear in the path of a mathematician, physicist, biologist, engineer and economist. The central topic of the course is the concept of a differential equation as mathematical description of a model in mechanics, electromagnetism, populations' dynamics, financial applications, etc.; as well as processes that are dependent on spatial and time arguments, and the principal methods for solving differential equations.	None	MATE 1207 - Vector Calculus	3

Department code	Course Number	Department name	Course Name	Course Description	Course co-requisites	Course prerequisites	Credits
QUIM	1103	Chemistry	Chemistry	This course provides the student with the knowledge to understand some of the main concepts and laws that are used to explain, through appropriate models, the transformations of matter and its interaction with energy. This is done by the study and review of experiments, principles and theories that allow the reliable prediction of these interactions. The course will introduce the student to topics related to atomic and molecular structure, stoichiometry, equilibrium and chemical kinetics. Laboratory: The laboratory of Chemistry comprises practices where experiments are carried out in order to reinforce the knowledge acquired in the Chemistry course. The experiments cover basic topics such as atomic structure, stoichiometry, calorimetry, gases, chemical equilibrium, etc.	None	None	3
QUIM	1105	Chemistry	Applications of Chemistry	This course, Applications of Chemistry, looks at the different roles of chemistry from an applied perspective, where the most important role is played by organic chemistry because of the high level of interest in this important branch of chemistry, both in the laboratory and in industry.	None	QUIM 1103 - Chemistry	3
QUIM	1618	Chemistry	Fundamentals of Chemical Analysis	This course, Fundamentals of Chemical Analysis, provides students the necessary tools to interpret correctly experimental data. It also provides students all the foundation for the study and use of the main analytical techniques used in chemistry.	None	QUIM 1105 - Applied Chemistry	3
QUIM	1301	Chemistry	Organic Chemistry	This course includes an applied perspective on the functions of chemistry and explicitly the area of Organic Chemistry. Students understand different processes that involve organic chemistry at laboratory and industrial level as the applications in various fields, such as food industry, agrochemicals, dyes, fuels, drugs and polymers.	QUIM 1302 - Organic Chemistry Laboratory	QUIM 1103 - Chemistry	3
QUIM	1302	Chemistry	Organic Chemistry Laboratory	This course focuses on the experimental component of Organic Chemistry and seeks to teach the student the management and use of material and equipment commonly used in Laboratory work. In addition, this course train student in the evaluation of purity, separation and analysis of organic compounds.	QUIM 1301 - Organic Chemistry	None	1
<b>General Education (compulsory courses)</b>							
DERE	1300	Law	Constitutional Law and Democracy	This course constitutes a general policy of the University that responds to the constitutional mandate of Constitutional Law teaching. Its central mission is to strengthen the student's critical knowledge and the capacity of acting according to values that, as citizens, it is indispensable to have, for a responsible exercise of his/her duties and rights.	None	None	3
LENG	1501	Languages	Spanish: Writing of academic texts	This course promotes the critical and analytical thinking skills of students by improving the understanding and production of academic texts. The course seeks to encourage logic- language formation, allowing students to read and write a text using principles of critical, reflexive, multiple, inter and trans-disciplinary knowledge, with all academic rigor. This requires students to identify the relationship between language and meaning, and develop the necessary skills for the comprehension and critical production of academic texts. Additionally the course encourages students becoming aware of the responsibility of their productions and interpretations	None	None	3
LITE	1611	Literature	Spanish	This course is designed to promote reading and writing skills that allow students to properly face the intellectual challenges that they will find in their academic and professional lives. Firstly, the course encourages students to read articles, reports or books written for a specialized audience. Secondly, it stimulates students to make connections between various sources and compare different types of explanations. Thirdly, it exhorts students to construct academic arguments based on substantiated, independent and critical positions.	None	None	3