Santiago de Cali, Colombia, September 10th, 2019

The Software Systems Engineering Bachelor Program of Universidad Icesi is a Program accredited by the Engineering Accreditation Commission of ABET (USA), since 2015, which can be verified in the online system of ABET:
https://amspub.abet.org/aps/name-search?searchType=institution&keyword=ICESI

This document presents the syllabus of the program, and describes its graduation requirements and main curricular components.

In the event of requiring further information about any aspect of our Software Systems Engineering Program, please do not hesitate to contact me.

Sincerely,

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Program Curriculum

1 Plan of Study

Our program curriculum, following the IEEE CS/ACM Curriculum Guidelines for Undergraduate Degree Programs in Computer Science,[1] provides a balanced breadth and depth coverage of the computing knowledge areas required by ABET, which are most related to the topics implied by the program title (Software Systems Engineering), and its educational objectives.

Table 1-1 presents the plan of study for the Software Systems Engineering (SSE) Program. Main academic terms in Universidad Icesi are based on semesters. Each academic year comprises two semesters of 18 weeks each (16 weeks dedicated to instruction plus two weeks devoted to final examinations). The first semester of the year, Spring, starts at the beginning of January and ends by May, whereas the second semester, Fall, starts at the end of July and ends by November.

Besides the courses presented in Table 1-1, Universidad Icesi requires students to demonstrate proficiency in eight levels of English. Once students are enrolled in the first semester of their program, the University applies an English proficiency examination. Students who demonstrate to have the required proficiency level are free to take other language courses offered by the university, which are included in the tuition. Universidad Icesi also requires students to demonstrate proficiency in the usage of productivity software for their academic work (i.e., MS Power Point, Word and Excel). Similar to the English requirement, there is a proficiency examination that is applied during the first week of the first semester of enrollment. Students that do not demonstrate to have the required proficiency level must enroll in courses offered by the University at no extra cost.

Table 1-1 below outlines the plan of study for students in the Software Systems Engineering program. All required courses are offered every semester and there is only one curricular track.

[1] Computer Science Curricula 2013 - Curriculum Guidelines for Undergraduate Degree Programs in Computer Science. The Joint Task Force on Computing Curricula Association for Computing Machinery (ACM) IEEE Computer Society, 2013

Table 1-1 Software Systems Engineering Curriculum

Course (Department, Number, Title)			Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.	*Subject Area (Credit Hours)*			
List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.				Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other
Department	Number	Title					
Organizational Management	01302	Organizations	R				2
Mathematics and Statistics	08272	Algebra and Functions	R	4			
Mathematics and Statistics	08273	Formal Logic and Argumentation	R	3			
Information and Communications Technologies	09702	Introduction to Engineering and ICT	R		2		
Languages	16001	Written Communication I	R			3	
Mathematics and Statistics	08091	Linear Algebra	R	3			
Mathematics and Statistics	08274	Single Variable Calculus	R	4			
Information and Communications Technologies	09703	Algorithms and Programming I	R		3		
Languages	16002	Oral and Written Communication II	R			3	
Biological Sciences	21108	Elective in Biology	SE			3	
Economics	06221	Principles of Economics	R				*3*
Mathematics and Statistics	08131	Probability	R	3			
Mathematics and Statistics	08275	Multiple Variable Calculus	R	4			

Course (Department, Number, Title)			Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.	*Subject Area (Credit Hours)*			
List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.				Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other
Department	Number	Title					
Information and Communications Technologies	09704	Algorithms and Programming II	R		3		
Physics Sciences and Technologies	11238	Physics and Lab	R	4			
Humanities; Social studies; Political studies; and psychological Studies	02222	Elective in Humanities and Social sciences I	SE			3	
Finances	04170	Accounting and Costs	R				*3*
Mathematics and Statistics	08171	Statistical Inference	R	3			
Information and Communications Technologies	09441	Process Engineering	R		2		
Information and Communications Technologies	09687	Algorithms and Data Structures	R		3 (√)		
Physics Sciences and Technologies	11239	Electricity & Magnetism and Lab	R	4			
Marketing and International Businesses	03097	Introduction to Marketing	R				3
Finances	04121	Economics Engineering	R				4
Mathematics and Statistics	08276	Discrete Mathematics	R	3			
Information and Communications Technologies	09706	Information Systems Modeling	R		2		

Course (Department, Number, Title)			Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.	*Subject Area (Credit Hours)*			
List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.				Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other
Department	Number	Title					
Information and Communications Technologies	09707	Capstone project I	R		3 (√)		
Social Studies	23121	Elective in Science, Technology and Society	SE			2	
Mathematics and Statistics	08289	Theoretical Informatics	R	3			
Information and Communications Technologies	09551	Databases	R		3 (√)		
Information and Communications Technologies	09705	Software Engineering	R		3		
Information and Communications Technologies	09711	Computer Networks Lab	R		4		
Physics Sciences and Technologies	11121	Digital Logic	R	4			
Industrial Engineering	05214	Production and Supply Chains	R				*3*
Information and Communications Technologies	09331	IT Project Management	R		3		
Information and Communications Technologies	09481	Artificial Intelligence	R		3		
Information and Communications Technologies	09710	Software architecture	R		3 (√)		

Course (Department, Number, Title)			Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.	*Subject Area (Credit Hours)*			
List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.				Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other
Department	Number	Title					
Information and Communications Technologies	09739	Internet Computing	R		2		
Physics Sciences and Technologies	11313	Computer Architecture and Lab	R		3		
Humanities; Social studies; Political studies; and psychological Studies	02223	Elective in Humanities and Social Sciences II	SE			3	
Information and Communications Technologies	09624	Professional Elective I	SE		3		
Information and Communications Technologies	09627	Operating Systems	R		3		
Information and Communications Technologies	09635	Graduation Project I	R		2		
Information and Communications Technologies	09713	Capstone project II	R		3 (√)		
Entrepreneurship	15000	Entrepreneurial Creativity	R				*4*
Organizational Management	01303	Leadership	R				*3*
Humanities; Social studies; Political studies; and psychological Studies	02224	Elective in Humanities and Social sciences III	SE			3	
Information and Communications Technologies	09621	Graduation Project II	R		3 (√)		

Course (Department, Number, Title)			Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.	*Subject Area (Credit Hours)*			
List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.				Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other
Department	Number	Title					
Information and Communications Technologies	09625	Professional Elective II	SE		3		
Information and Communications Technologies	09644	Professional Elective III	SE		3		
Information and Communications Technologies	09714	Principles of Information Security	R		3		
Professional Development	09714	Professional Internship	R		10		
Legal Studies	10094	Introduction to Constitutional Law	R			3	
Legal Studies	24050	Elective in Ethics	SE			2	
Add rows as needed to show all courses in the curriculum.							
TOTALS-ABET BASIC-LEVEL REQUIREMENTS				42	78	25	25
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM		167					
PERCENT OF TOTAL				25%	47%	14%	14%
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours			32 Hours	48 Hours		
	Minimum Percentage			25%	37.5 %		

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.
2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.Instructional materials and student work verifying compliance with ABET criteria for the categories indicated above will be provided during the campus visit.

Table 1-2 Summary of significant design experiences

Semester	Course	Credit Hours	Design Experience Description
4	09687 – Algorithms and Data Structures	3	In this course students must solve problems based on the use of data structures, analysis of algorithms and classical computing algorithms. Significant design experiences in this course are based on problems where students produce detailed designs (abstract data types and class diagrams) that exploit data structures according to constraints and quality criteria associated with the problem. These designs must be integrated into the course project to be developed following a defined process that implies analysis, planning, application design, automatic testing, and documentation.
5	09707 – Capstone Project I	3	Students develop a course project working in small groups. The project consists in developing a software o medium complexity, where students must deal with a considerable amount of data that posit demanding requirements from the perspective of algorithmic complexity. The significant design experience focuses on the development of system structure (detailed) design diagrams required by the project, where data structures must be properly articulated.
6	09551 - Databases	3	This course focuses on the theory and practice of relational database (detailed) design. Significant design experiences in the course are realized through activities in which students depart from a given entity-relationship model (ERM), and a set of quality requirements (integrity, redundancy and performance) to propose logical and physical database design alternatives, and implement prototypes that meet these design specifications.
7	09710 – Software Architecture	3	This course focuses on the elements that define the structure and behavior of the software architecture, the relationships that can occur between these elements, and how the software architecture is specified in a standardized notation such as UML. The significant design experience is realized through practical group assignments where students design the system architecture (global design) in terms of the hardware architecture and communication links as complements of the software architecture to guarantee quality attributes.
8	09713 – Capstone Project II	3	This course is the program's major design experience. It relies on a problem-based learning strategy, in which all students simulate to be part of the same software engineering company. The project focuses on solving a problem of a real organization through the

			development of a software system by following a software engineering process that is planned and controlled. This major design experience allows students to fully exercise four levels of software design: process design, software architecture (global) design, database (detailed) design, structure and behavior (detailed) design. A comprehensive explanation of this major design experience is presented in Sect.5.A.6.
9	09621 – Graduation Project II	3	Students conceive, design and implement a software computing system aimed at solving a problem identified by themselves, guided by a faculty member. The problems solved in graduation projects usually correspond to real needs of companies or faculty research projects. Design deliverables usually include UML class diagrams, entity-relationship models, UML sequence diagrams, and UML deployment diagrams.

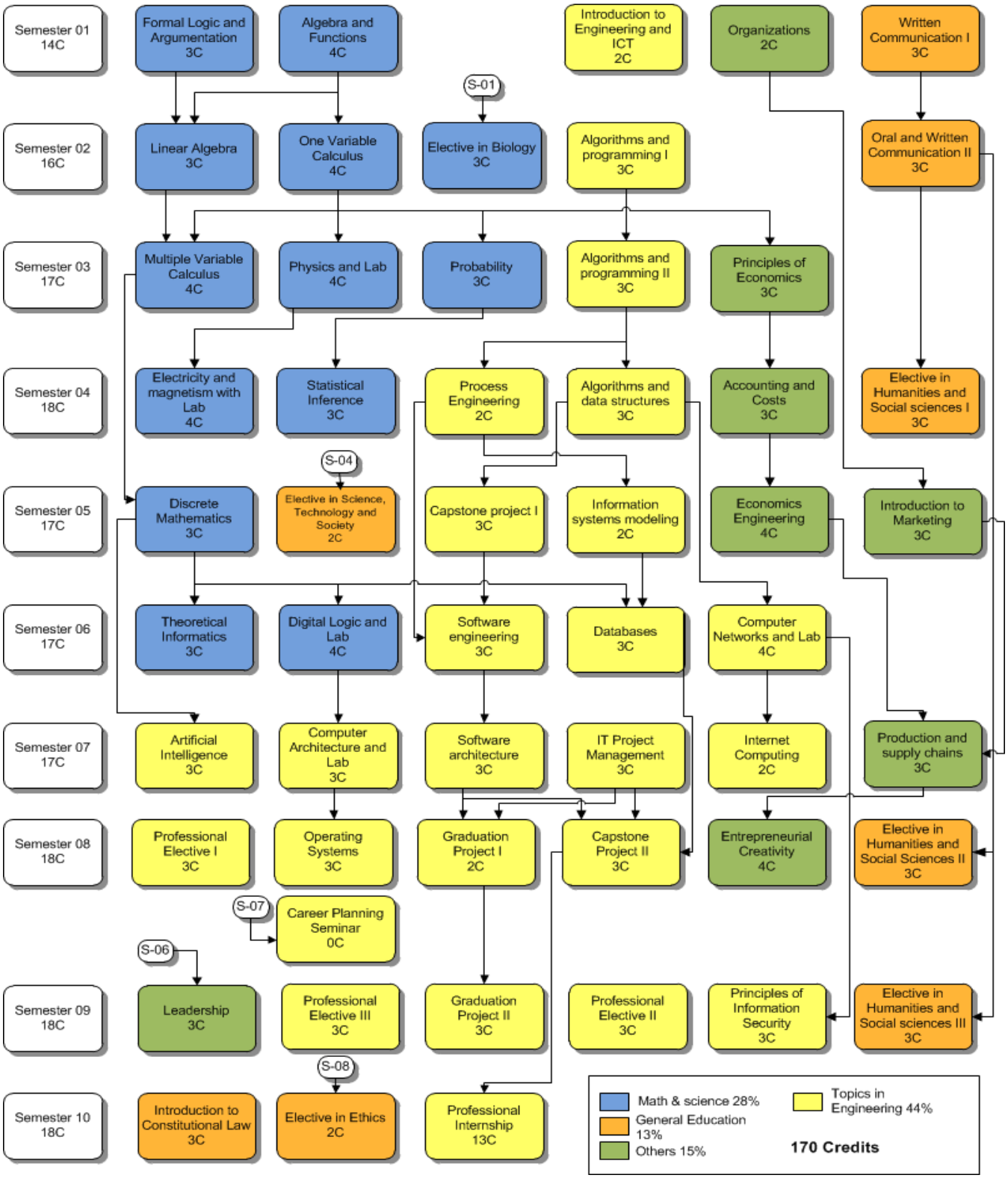

Figure 1–1 Course Prerequisite Structure

2 Degree Requirements

To graduate, students must complete 170 credit hours. Courses in the curriculum of the SSE are classified into four groups: 1) math and science, 2) general education, 3) professional core (topics in engineering), and 4) business management (cf. column "Other" in Table 1-1).

Courses in math and basic sciences (42 credit hours), together with general education (25 credit hours), comprise what Universidad Icesi names as the *central curriculum*.

Math and Basic Sciences includes courses in mathematics, physics and an elective in Biology. Besides the foundational math and sciences courses, this area also includes a set of courses that are foundational for software systems engineers: *08273 - Formal Logic and Argumentation, 08131 Probability, 08171 - Statistical Inference, 08276 - Discrete Mathematics, and 08289 - Theoretical Informatics*. It is important to point out that discrete mathematics and theoretical informatics are courses managed by the Department of Mathematics, rather than the Information and Communications Technologies Department (the department to which the SSE program is affiliated).

General Education includes courses in written and oral communication, three electives in humanities and social sciences, an elective in ethics, a foundational course in constitutional law, and eight courses of English that can be fully or partially validated through a proficiency examination. English courses do not apply to students that hold an International Baccalaureate (IB) diploma.

Courses in engineering topics are designed based on the CDIO framework.[2] That is, our engineering curriculum provides students with learning experiences oriented to the design, conception, implementation and operation of software systems. This area constitutes the professional core of the program and corresponds to 78 credit hours. We classify these courses into four components:

1. *Algorithms and programming*: this component provides students with the depth requirement in topics associated with the **implementation** of software systems (algorithms and programming topics), and foundational topics related to the **analysis** and **design** of software engineering solutions. This component includes two courses in object oriented programming, a course in data structures and analysis of algorithms, and a capstone course that provides students with a learning experience that allows them to apply the concepts learned in the courses of this component, to problems very similar to the ones in real life situations. This course is also one of the assessment sources for outcomes c (design) and k (techniques and tools).
2. *Computing Infrastructure*: this component provides students with knowledge associated with the computing infrastructure required to support the correct **design**, **implementation** and **operation** of software systems. This component includes a course in computer networks, a course in operating systems, a course in computer architectures, and an introductory course in information security.

[2] http://www.cdio.org/

3. *Software engineering and information systems*: this component provides the depth requirement in the topics associated with the **analysis**, **design**, and **operation** of software systems.

With respect to software engineering, this component includes the following courses:

a. *09441 – Process Engineering*: At the end of the course students are able to use the principles of General Systems Theory to describe situations and organizations as systems. With respect to software engineering processes, students are prepared to explain the CMMI-Dev model, by identifying the maturity level two process areas. Students use ISO 9001 to characterize processes of both general systems and the studied areas of CMMI-Dev.
b. *09705 – Software Engineering*: this course is devoted to the study of the software engineering life cycle, from a quality and continuous improvement perspective. At the end of the course students are able to explain the differences between prescriptive and agile software development models, as well as to apply models and techniques to the elicitation, analysis and specification of requirements, and to the detailed design and quality assurance of software systems. Furthermore, students are able to explain the application of umbrella activities that are transversal to the software engineering life cycle: planning and control, configuration management, and quality assurance.
c. *09710 – Software Architecture*: this course focuses on the elements that define the structure and behavior of software architectures, the relationships among these elements and their specification in a standard notation such as UML. At the end of the course, students are prepared to design a software architecture that addresses most significant functional and non-functional requirements.
d. *09713 – Capstone Project II*: in this course all enrolled students must work as single software engineering team on a project required from any of our industrial partners. This course provides students with a learning experience that allows them to apply the knowledge acquired in the curriculum to the analysis, design, implementation, and validation of a software system. Consequently, it constitutes a major source of assessment for outcomes c (design), d (multidisciplinary teaming, and k (techniques and tools).
e. *Elective courses*: this component includes electives in topics such as software testing, design patterns, and self-adaptive software.

With respect to information systems, this component includes a course in information systems modeling, a course in data bases, a course in artificial intelligence, and several elective courses in topics such as big data analytics, IT management, and the application of new technologies to the engineering of information systems.

4. *IT Project Management*: this component provides students with topics and skills required to actively participate in IT projects. It includes a course in IT management that focuses on strategic planning, project evaluation and project management using the PMI[3] approach; and two graduation project courses. Occasionally, an elective is offered under this component.

[3] http://www.pmi.org/

Students must complete 25 credit hours in courses related to business management. This is because the program has a special interest in graduating software systems engineers that are recognized not only by their technical strengths, but also by professional skills that allow them to understand businesses and support them in the achievement of their missions. These courses are also important for promoting entrepreneurship, a major focus at Universidad Icesi.

In summary, and as presented in Table 1-1, to obtain their degree students must complete 42 credit hours in Math and Basic Sciences (10 more credits than the minimum required by ABET), 78 credit hours in Engineering Topics (30 more credits than ABET's minimum requirement), 25 credit hours in General Education, and 25 credit hours in business administration topics. Percentage-wise, the minimum ABET requirement for math and science is 25%, and for topics in engineering it is 37.5%. Our SSE program complies with this these requirements with 25% and 46%, respectively.

The 78 credits devoted to engineering topics include a graduation project that lasts between two and three semesters, and a mandatory co-op experience. The graduation project is supervised by a faculty member of the ICT department, and may be focused on either solving an engineering problem or contributing to a research project. Very frequently, engineering problems correspond to real life needs of Colombian companies. The involved company supports the project by assigning an engineer who acts as a co-supervisor of the project. Graduation projects are developed through the courses *09635 – Graduation Project I and 09621 – Graduation Project II*, which are capstone projects focused on the development of professional skills such as project management, problem solving, and communication. These courses are important assessment sources for outcomes e (problem solving) and g (effective communication). The co-op experience is a software systems engineering professional internship that must last no less than 6 months.

3 Major Design Experience

Students of the SSE program are exposed to different and gradually deepening design experiences throughout the curriculum. These experiences culminate with an intermediate design experience in the "Capstone Project I" course in the fifth semester, and a major design experience in the "Capstone Project II" course in the eighth semester. Design experiences in the SSE program are explained as follows.

As explained in Section 2, the students start with the Algorithms and Programming curricular component. Even though the first course of this component focuses on coding a solution in Java, the second and third courses gradually demand more and deeper design activities, culminating in "Capstone Project I". The accumulated design experience is expressed in terms of abstract data types and class diagrams including all of their associated concepts (i.e., classes, interfaces, relationships, inheritance, etc.), and evidenced in the design of a small but significant software system. Examples of projects developed in the last years are the modeling, implementation and simulation of the local "MIO" public

transportation system, and the design and implementation of recommender systems for a national grocery store and for an online movie system.

The Software Engineering and Information Systems component introduces the design process formally: the "Software Engineering" course at the detailed level, focusing on the design to satisfy functional requirements, and the "Software Architecture" course at the architectural level, focusing on the satisfaction of non-functional requirements and especially of quality attributes. The "Information Systems Modeling" course provides the basis for the design of transactional systems, focusing on their operations and data modeling, whereas the "Databases" course focuses on the detailed design of data (relational) models, including their normalization, and considering space and time constraints, both at the physical and logical levels.

The Computing Infrastructure component provides fundamentals that complement the design process of software systems to satisfy design constraints and quality attributes, thus leveraged in the "Software Architecture" course. This component also includes a course in computer architecture, a course in operating systems, a course in computer networks, and an introductory course in information security. The first two courses provide important details for the design of the interaction and dependencies of software systems with the underlying computational infrastructure. The "Computer Networks" course studies the fundamentals that support the design of distributed software, whereas the "Principles of Information Security" course, the principles for designing secure software systems.

Finally, the course that concentrates the major software design experience is "Capstone Project II". This course leads the students to exercise the cumulus of knowledge acquired in previous courses in the program, concerning the software development life-cycle and project management. In effect, in this course the students are instructed to integrate a software development company, in groups of maximum 15 people. In the exercise, the students must make their own decisions on all aspects about their "software company", not only by following the Colombian regulation for creating companies, but also by designing and developing a significant software product for a "real" client while satisfying plausible design constraints. To this end, the software company must adopt an appropriate software development life-cycle model and suitable engineering standards. For the software design and development, students must work together by defining sub-teams, with enterprise (i.e., economics) criteria. Course sessions are devoted primarily to reviewing the group decisions on the project design and implementation, occasionally by including technical workshops on the practical application of specific topics.

During the last two academic years in which the course has been offered, students have developed capstone projects on online store retail systems, call-for-project management systems, and home-health management systems. The requirements have been elicited from---and validated with---local companies, and even with the department of research-support of the University.

The course has been conceived for the students to fully exercise four levels of software design:

1. *Process design*: this level of design applies in two instances. The first, for the software company itself, to design the software development process to be followed by the students themselves. The second, to model the processes that the required software will support in the client's enterprise. Process design is specified in Unified Modeling Language (UML) activity diagrams.
2. *Software architecture (global) design*: this level focuses on the specification of significant software components and relationships that define the structure and behavior of the software required by the client. It also concerns the mapping of these software components to physical components (i.e., hardware elements), and how these physical components are interconnected. Architecture design is specified in UML deployment diagrams.
3. *Database (detailed) design*: as its name implies, this level is concerned with the detailed design of the data persistence layer, in terms of database tables and relationships that satisfies the client's requirements. This design implies warranties on data integrity, and space and time efficiency. Database design is specified in relational diagrams.
4. *Software structure and behavior (detailed) design*: this is the lowest level of design, and its goal is to generate design specifications that provide enough information to implement the structure and behavior of the designed software artifacts specified at the architectural design level. Structural design is specified in UML class diagrams, while behavioral design in UML sequence diagrams.

Regarding the usage of tools, the students generally use Visual Paradigm community edition for the generation of UML design artifacts; Oracle Data Modeler for the design of the database model; and GForge for hosting the project artifacts, controlling versions and tasks, as well as managing documents.

To attain the course objectives, it is necessary to carefully select the projects to be developed. These projects must involve interaction with users through GUIs, data persistence through databases, and significant business logic.

4 Cooperative Education

The SSE program has a mandatory co-op experience that corresponds to a six month professional internship, usually conducted in the last semester. In their internship, students work full time in industry as if they were already professionals. Universidad Icesi guarantees that all students find an internship according to the program. Professional internships are managed by the Professional Development Center[4] (CDEP for its name in Spanish) and include a three-semester mentoring plan that starts in semester eight.

The first semester is devoted to the career planning seminar that provides students with useful tools and skills to succeed not only in their internship, but also in their careers. The goal of this seminar is to sensitize students through learning experiences based on training workshops that discuss topics such as preparation for interviews, the job market, and the

[4] http://www.icesi.edu.co/cedep/

process of transitioning from students to professionals. The second semester focuses on the process of finding the professional internship that fits the requirements of the program and hopefully the expectations of the student. Finally, the mentoring program continues in the third semester while the student is enrolled in the company as an intern. Every student is assigned to a mentor who accompanies his/her internship process through periodic meetings, mediates between the student and the company when required, and in collaboration with the company assess the performance of the student. Professional internships may be conducted abroad. Furthermore, students interested in creating their own business can focus their internship on the development of an entrepreneurship project. In the latter case, the program is also supported by the Development Center of Entrepreneurship[5] (CDEE for its name in Spanish) through a mentoring program that includes all the facilities[6] required by the entrepreneur.

The professional internship can be approved or not approved, depending on whether the student accomplishes the established goals. These goals are defined between the student and the employer, under the supervision of the mentor assigned by the university. In the case of entrepreneurial projects, the goals are defined between the student, the CDEE center, and the Director of the SSE program.

Course Syllabi

Appendix A includes a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements, as well as the software engineering criteria.

[5] http://www.icesi.edu.co/cdee/
[6] http://www.icesi.edu.co/cdee/start-upcafe/

APPENDICES

Appendix A – Course Syllabi

Semester 1

1. 08273- Formal Logic and Argumentation

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name:
   Luis Eduardo Munera

4. Text book, title, author, and year
   - Lógica y Argumentación: de los argumentos inductivos a las álgebras de Boole. A. Bustamante A. Pearson Educación, 2009.

   Other supplemental materials:
   - Introducción a la Lógica. Irving Copi y Carl Cohen. Limusa, 2004;
   - Desatinos. Robert Gula, Editorial Norma, 1981.
   - Las Claves de la Argumentación. Anthony Weston, editorial Ariel, S.A, 2005.

5. Specific course information:

   a) Brief description of the content of the course (catalog description):
   The students will be able to recognize and build arguments and on them the conclusion and premises, the way in which the premises support the conclusion, and represent this relationship in a diagram.
   They will be also able to establish the validity or invalidity of deductive arguments in general and syllogisms in particular using their symbolic representations in the propositional or predicate calculus, if that is the case. They will have the capacity to use logical reasoning and valid arguments in approaching and solving problems like those of LSAT (The Law School Admission Test) and PAEP (Admission Test to Graduate Studies. Tech Monterrey). Finally, they will be able to analyze, interpret and write argumentative texts.

   b) Prerequisite or co-requisites: None.

   c) Indicate whether a required, elective, or selected elective (as per Table 1-1) course in the program: Required.

6. Specific goals for the course

d) Specific outcomes of instruction:
The students who pass this course will have the language skills and logical reasoning abilities required for doing, analyzing and evaluating deductive, inductive and abductive arguments, and to use the foundations of logic in the different scenarios of everyday life when required, in the production academic texts and participation in debates, among others. They are expected to generate appreciation and inclination towards using precise reasoning, deductive processes and formal systems.

e) Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:
- Outcome A: an ability to apply knowledge of mathematics, science, as well as computing and software engineering : introduce (I)
- Outcome G: an ability to communicate effectively orally and written, both in Spanish and English: teaching (T)

7. Brief list of topics to be covered:

Types of arguments. Premises, conclusion, validity and invalidity, structure of arguments, analysis of arguments and argumentative texts, categorical syllogisms, formal and informal fallacies, propositional logic, inference rules, predicate logic.

1. **09702- Introduction to Engineering and ICT**

2. Credits (2) contact hours(2)

3. Instructor or course coordinator's name
   Jose D. Maldonado.

4. Text book title, author (s), and year:
   - Wright, Paul (2002). Introduction to Engineering. Wiley

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   The aim of this course is for students to recognize the software systems engineer's role in society, through identification of opportunities for applying information and communication technologies (ICT) to solve problems. The course also allows the student to define and solve simple engineering problems.

   b) Prerequisite or co-requisites: None

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   - Specific outcomes of instruction:
   After completing the course, students will be able to:
     - Explain the role and contribution of the Software Systems Engineer to society.
     - Solve simple problems in the context of software systems engineering, using the engineering method, and algorithmic thinking.

   - Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
     - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: teaching (T)
     - Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: introduce (I)
     - Outcome F: An understanding of professional and ethical responsibility. Level: teaching (T)
     - Outcome J: Knowledge of contemporary issues (i.e. ongoing issues where public interests are at stake). Level: introduce (I)

- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: teaching (T)

7. Brief list of topics to be covered
   - Problem Solving Method in Systems Software engineering
   - Frameworks for solution problems construction
   - Software development team for Design Implementation
   - Role of Systems Software Engineer

Semester 2

1. **09703- Algorithms and programming I**

2. Credits (3) contact hours(5)

3. Instructor or course coordinator's name
   Juan Manuel Reyes

4. Text book title, author (s), and year:
   - Fundamentos de programación: Aprendizaje activo basado en casos. Villalobos Jorge A, Casallas Rubby Editorial Pearson Educación, 2006.
   - Conceptos Básicos de Programación con Java. Luz Elena Jiménez Third Edición (2008).
   - Java 2: Curso de programación. Francisco Javier Ceballos. Alfaomega 2003.
   - Fundamentos de programación en Java 2. Schmidt Herbert. 2001.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   This is an introductory course in programming. It teaches the students the tools and techniques to solve simple problems, using a computer program.

   Prerequisite or co-requisites: None

   b) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   - Specific outcomes of instruction:
   At the end of the course the student will be able to: a) Analyze and specify a simple problem, through documentation of functional requirements and definition of a model; b) propose a solution to a programming problem, and c) solve the problem, turning models into algorithms and computer programs.

   - Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
     - Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: teaching (T)
     - Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: teaching (T)

7. Brief list of topics to be covered
    - Problems, solutions and programs
    - Defining situations, handling cases
    - Handling attribute groups
    - Building a GUI
    - Two-dimensional data structures and persistence

Semester 3

1. **09704 - Algorithms and programming II**

2. Credits (3) contact hours(5)

3. Instructor or course coordinator's name
   Juan Manuel Reyes

4. Text book title, author (s), and year:
   - Introducción a las estructuras de datos, Villalobos, Jorge A. Aprendizaje activo basado en casos. Editorial Prentice---Hall, 2008.
   - Weiss, Mark Allen; Estructuras de datos en Java. Cuarta edición Pearson, 2010

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   This course is intended that each student have the knowledge in the area of programming that allows you to implement algorithmic solutions to solve problems. This being the second year of a block of training, new concepts is introduced to model the entities worldwide and techniques for implementing algorithms that solve some complex problems. This course is part of a block of incremental knowledge, so it is assumed that the student has the knowledge gained in the previous course of algorithms and programming I.

   b) Prerequisite or co-requisites: 09703 Algorithms and programming I

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   a) Specific outcomes of instruction:
   Apply the concepts of object-oriented programming techniques and some troubleshooting to medium complexity programming, following a development process and including good programming practices.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: teaching (T)
      - Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: teaching (T)

7. Brief list of topics to be covered
    - Search, sorting and automated test
    - Files, serialization and exception types
    - Linked linear structures
    - Reuse and uncoupling mechanisms
    - Recursive algorithms and concurrency

1. **11238 - Physics and Lab**

2. Credits (4) contact hours(4)

3. Instructor's or course coordinator's name:
   Gustavo Murillo Yepes

4. Text book title, author (s), and year:
   - Física para Ingeniería y Ciencias, Volumen I, Wolfgang Bauer,Gary D. Westfall., Mc Graw Hill.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
      The physics course and laboratory belongs to the group of basic science courses that all engineering and natural sciences careers take as part of their scientific and technical training. The students will formulate the equations of motion of a particle, identifying the type of movement. Propose and solve one-dimensional and two-dimensional kinematics. Apply the physical laws of Newtonian mechanics to specific cases using the first, second and third law of Newton and compare the experimental results with the theory and proposed in class and draw their own conclusions hypothesis.

   b) Prerequisites: 08274 - One Variable Calculus
      Co-requisites: 11315 - Physics Lab

   c) Indicate whether a required, elective, or selected elective (as per Table 1-1) course in the program: Required

6. Specific goals for the course

   - Specific outcomes of instruction:
     Upon completion of this course the student will be able to describe the macroscopic world around them, will explain how the bodies move and the most common interactions between them and the physical environment in which they moving. In particular, the students can understand how simple machines work and use the conservation laws to address real or hypothetical situations of their environment, that is, you can troubleshoot the mechanical world and will be able to apply theoretical concepts studied in the implementation of experimental setups at the laboratory.

   - Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:
     - Outcome B: An ability to design and conduct experiments, as well as to analyze and interpret data. Level: teaching (T)

- Outcome H: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Level: introduce (I)

7. Brief list of topics to be covered
   - Motion of a particle
   - Laws of Motion
   - Work, Power and Energy
   - Linear Momentum and Collisions
   - Rotating of rigid body and the angular momentum

Semester 4

1. **08171 - Statistical Inference**

2. Credits (3) contact hours(4)

3. Instructor's or course coordinator's
   Ernesto Peláez García

4. Text book title, author (s), and year:
   - Estadística aplicada a los negocios y la Economía. Lind, Marchal, Wathen. Editorial Mc Graw Hill.Décimo quinta edición 2012.
   - The course is online in Moodle Tool with workshops exercises and slides of all themes

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   The students will make decisions based on analysis of information quantifying the risks taken understanding of sampling distributions and their impact on decision making based on sampling. Also, will raise settle and analyze testing hypotheses about population parameters most used.

   The students will use and evaluate the use of Microsoft Excel in processing information and troubleshooting Statistical inference identifying, implementing and analyzing the method of simple linear regression and correlation analysis

   b) Prerequisite or co-requisites: 08131- Probability.

   c) Indicate whether a required, elective, or selected elective (as per Table 1-1) course in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end of this course, students will be able to: Describe, use and interpret the results of methods that make it possible to estimate one or more characteristics of a population of interest, or making a decision about a population based results only in a sample.

   b) Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:
      - Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level: apply (A)

7. Brief list of topics to be covered

- Definitions of Sampling Methods (Reasons to sample, Simple Random Sampling, Systematic Random Sampling, Stratified Random Sampling, Cluster Sampling)
- Sampling Distributions:
- Sampling error, Central Limit Theorem, Sample Mean, Sample Proportion, Sample Variance.
- Sampling Distribution of the sample Mean.
- Standard error of the Mean.
- Using the sampling distribution of the sample mean.
- Using the sampling distribution of the sample proportion.
- Using the sampling distribution of the sample variance.
- Point Estimate and Confidence Intervals for a Populations Parameters.
- Sample Size to estimate Populations parameters.
- One Sample Test of Hypothesis. (definition of hypothesis tests, Explanation of hypothesis testing procedure, Type I and II errors, using the test statistic, one tailed and two tailed test of hypothesis, compute and interpret a p-value, conduct a test of hypothesis about a population mean and population proportion, compute the probability of a Type II error)
- Two Sample Test of Hypothesis. (Independent samples: two sample test of means known σ. Two sample test of means unknown σ. Two sample test about proportions. Comparing two population Variances. Two sample test of hypothesis: dependent samples).
- One way ANOVA test. Inference about pairs of Treatment means.
- Two way ANOVA test.
- Goodness of fit test with Chi square.
- Contingency Table Analysis
- Correlation and Linear Regression Model

1. **09441 - Process Engineering**

2. Credits (2) contact hours(3)

3. Instructor or course coordinator's name
   Julián Cifuentes

4. Text book title, author (s), and year:
   - Introducción a la Teoría General de Sistemas. Oscar Johansen. LIMUSA. 1993
   - Gestión de Procesos, Luis Agudelo Tobón y Jorge Escobar. ICONTEC, 2007.
   - ISO 9001:2008, Sistemas de Gestión de la Calidad - Requisitos. ISO, 2008.
   - CMMI for Development: Guidelines for process integration and product improvement Chrissis, Mary Beth; Konrad, Mike; Shrum, Sandy. Addison Wesley, 2011.
   - Software Engineering Institute. CMMI para Desarrollo, Versión 1.3. Technical report. 2010.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   Use the principles of General Systems Theory to describe situations such organizations and systems, using the process approach, and characterized under international standards and references, such as ISO 9001 and CMMI-Dev processes.

   b) Prerequisite or co-requisites: 09704 - Algorithms and programming II

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course
   a) Specific outcomes of instruction:
   At the end of the semester, the student will be able to:
      - Describe an organization as a system in its environment, according to the fundamentals of General Systems Theory.
      - Characterize sets of processes of an organization, according to ISO 9001. Explain the CMMI-Dev benchmark that applies to software development processes, identify areas of process level 2, and characterize them using ISO 9001

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: teaching (T)

- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: teaching (T)

7. Brief list of topics to be covered
    - General Systems Theory
    - Introduction to ISO 9001
    - Introduction to CMMI-Dev

1. **09687 - Algorithms and data structures**

2. Credits (3) contact hours (5)

3. Instructor or course coordinator's name
   Juan Manuel Reyes

4. Text book title, author (s), and year:
   - A practical Guide to Data Structures and Algorithms Using Java. Sally A. Goldman and Kenneth J. Goldman. 2009.
   - Data Structures and Problem Solving Using Java, 4/E.Mark A.Weiss. 2010.
   - The Algorithm Design Manual Springer.Steven Skienna. 1997.
   - Introduction to Algorithms. Thomas Cormen 2000.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   In this course students solve problems using data structures, algorithms and analysis of classical computing algorithms. In order to solve a problem, students will be able to design and implement data structures in main memory, given a set of constraints and quality criteria. These structures should be integrated into projects that include analysis, planning, application design, use of automated testing and documentation generation.

   b) Prerequisite or co-requisites: 09704 - Algorithms and programming II

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end of the course, the student will be able to:
      - Analyze, design and implement solutions to computing problems using classic data structures and algorithms, analyzing time complexity and following a systematic and disciplined process.
      - Differentiate the types of data structures, and select the best for solving a given problem
      - Design and implement linear data structures, direct-access structures, trees and graphs.
      - Design and implement unit tests for each of the data structures.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:

- Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level: apply (A)
- Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints . Level: teaching (T)
- Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: teaching (T)
- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: apply (A)

7. Brief list of topics to be covered
    - Time complexity analysis
    - Basic design of linear data structures and direct-access data structures
    - Recursive structures
    - Graphs

1. **11239 – Electricity & magnetism and Lab**

2. Credits (4) contact hours (5)

3. Instructor or course coordinator's name
   Gustavo Murrillo Yepes

4. Text book title, author (s), and year:
   - FÍSICA para ingeniería y ciencias, Volumen 2, W. Bauer y G. D. Westfall, Mc Graw Hill, México D. F., 2011

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   Electricity-magnetism and Lab course intended for engineering and science students for rigorous introduction to electricity and magnetism calculus-based. The objectives of this course are to tease out the laws of electricity and electromagnetism from our everyday experience by specific examples of how electromagnetic phenomena manifest themselves. The student be able to describe, in words, the ways in which various concepts in electricity and electromagnetism come into play in particular situations. They be able represent these electromagnetic phenomena and fields mathematically in those situations and to predict outcomes in other similar situations and recognize its importance in the scientific, technological and medical fields.

   b) Prerequisite or co-requisites: 11238 - Physics and Lab

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end of the course, it is expected that the student is able to use different coordinate systems and tools of vector calculus in solving problems of electricity and magnetism. Also, recognize the fundamental laws governing the electromagnetic interaction to charge distributions, stationary currents and time-dependent fields.

   Understand electrical circuits of DC and AC and processes for generation of electric and magnetic fields. Designing and building tools, involving the use of electrical circuits.

   Recognize the concepts of electromagnetic field and electromagnetic wave and the electromagnetic nature of light. Using the properties of waves to describe the electromagnetic spectrum. Apply the laws of electromagnetism to solve engineering problems.

By the last, recognize the scientific and technological value of Maxwell's electromagnetic theory.

a) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
    - Outcome B: An ability to design and conduct experiments, as well as to analyze and interpret data. Level: teaching (T)

7. Brief list of topics to be covered
    - Electric field and electric potential
    - Electrical circuits
    - Magnetic Fields
    - Electromagnetic Fields

Semester 5

1. **08276 – Discrete Mathematics**

2. Credits (3) Contact hours (4)

3. Instructor or course coordinator's name
   Jaime Andrés Castaño Perea

4. Text book title, author (s), and year:
   - Matemáticas Discretas y sus aplicaciones. Kenneth Rosen. Editorial McGraw HiIl. Quinta Edición.
   - Matemáticas Discretas. Richard Johnsonbaugh. Editorial Pearson. Sexta Edición.
   - Matemáticas Discretas. Con teoría de gráficas y combinatoria. T. Veerarajan. Mc Graw Hill.

5. Specific course information

   a) Brief description of the content of the course (catalog description):

   Once completed this course, the student will be able to recognize and properly apply the formal elements of discrete mathematics that are needed in telematic computing engineering, which are not part of the undergraduate courses of calculus and differential equations.

   b) Prerequisite or co-requisites: 08275 – Multiple variable calculus
   c) Indicate whether a required, elective, or selected elective (as per Table 1-1) course in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
      At the end of the course, it is expected that the student will be able to make use of the fundamental concepts of number theory and to use them to solve discrete computational problems. Also the students will be able to apply mathematical induction to show properties of countable sets and to verify recursive algorithms, to set up recurrence relations modeling real situations and computational applications and to resolve them. The students will analyze and classify binary relationships as of equivalence or as of order relationships and apply this concept to solve problems. Finally, the students will recognize the structure of Boolean algebra and apply their properties to the field of Digital Logic

   b) Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course:

- Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level: apply (A)

7. Brief list of topics to be covered
   - Methods for demonstrating.
   - Fundaments of Set Theory.
   - Functions.
   - Induction and recursion.
   - Recurrence relations.
   - Number Theory.
   - Equivalence ratios and partially ordered sets.
   - Boolean algebra.
   - Introduction to graph theory.

1. **09706 – Information systems modeling**

2. Credits (2) contact hours(3)

3. Instructor or course coordinator's name
   Guillermo Londoño

4. Text book title, author (s), and year:
   - Londoño Guillermo y Múnera Luis Eduardo, Ingeniería del Software: Modelado de datos y eventos. Universidad Icesi.
   - Lerman Julia, Programming_Entity_Framework_2nd_Edition: DbContext, O'Reilly 2012

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   This course aims to present principles and techniques to build domain-independent concept models of information systems, based on a dependency analysis among the concept's properties. Students also implement the entity model in a development environment, and query the model using an entity-relationship management language.

   b) Prerequisite or co-requisites: 09441 – Process Engineering

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end of the course, students will be able to: 1) Build a context-independent concept model, identifying the entities and the relationships among them; 2) Generate an entity-class model and a relational data model, from the concept model; 3) use an entity-relationship management language to query an entity model.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level: apply (A)
      - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: teaching (T)
      - Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: apply (A)

7. Brief list of topics to be covered

    - Modeling the behavior of an information system.
    - Independent modeling concepts.
    - Access to data using LINQ.

1. **09707 – Capstone project I**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Juan Manuel Reyes

4. Text book title, author (s), and year:
   - Sally A. Goldman and Kenneth J. Goldman. A Practical Guide to Data Structures and Algorithms Using Java. Boca Raton: Chapman & Hall/CRC, 2009.
   - http://goldman.cse.wustl.edu/
   - Mark A. Weiss. Data Structures and Problem Solving Using Java, 4/E . Addison-Wesley. 2010
   - Steven Skienna. The Algorithm Design Manual Springer. 1997
   - Jorge Villalobos. Diseño y manejo de Estructuras de Datos en C. McGraw-Hill/ Interamericana Editores. 2006

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   In this course, students must apply and integrate the concepts learned in the Algorithms and Programming I, Algorithms and Programming II, Algorithms and Data Structures and Process Engineering courses, forming teams to completely solve a proposed problem. The solution must meet specific time and space complexity constraints, process of significant volumes of data, and make use of new technologies.

   b) Prerequisite or co-requisites: 09687 – Algorithms and Data Structures.
   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end of the course, the student will be able to: a) Conceive, design and implement programs that provide solutions to medium-complexity problems, applying the object-oriented programming paradigm, as well as concurrency, recursion, searches, sorts, file management, and automated unit and integration tests; b) design data structures, considering time complexity constraints and memory consumption; c) build an algorithmic solution that allows the simulation of real situations involving significant volumes of data, and including application of statistical parameters to determine the discrete and continuous distributions describing the system.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:

- Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level apply (A)
- Outcome B: An ability to design and conduct experiments, as well as to analyze and interpret data. Level: apply (A)
- Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: apply (A)
- Outcome D: An ability to function on multidisciplinary teams. Level: teaching (T)
- Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: apply (A)
- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: apply (A)

7. Brief list of topics to be covered
    - Development of the proposed project.

Semester 6

1. **08289 – Theoretical Informatics**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Alfonso Bustamante Arias

4. Text book title, author (s), and year:
   - *Teoría de la computación: lenguajes, autómatas, gramáticas*. Rodrigo de Castro. Colección Notas de Clase, Facultad de Ciencias, Universidad Nacional de Colombia, 2003.
   - *Teoría de la computación*. Carrión Viramontes. Editorial Limusa, 2009.
   - *Lenguajes formales y teoría de la computación*. John Martin. Mc Graw-Hill. 3ra. edición, 2004.
   - *Introduction to the Theory of computation* (Second Edition. International Edition). Michael Sipser. Thompson course technology, 2006.
   - *Introducción a la teoría de autómatas, lenguajes y computación*. Hopcroft, Montovani, Ullman. Addison Wesley. 2002.
   - *Machines, Languages and Computation*. Denning, Dennis, Qualitz. Prentice-Hall, 1978.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   In this course, students will that a given relation is equivalence relation, and determine their equivalence classes and corresponding ratio set. Calculate and related reduced automaton equivalent to a given one, establish whether two given automata are equivalent or not, as implementation of the algorithm solve. Characterize the finite state automata, stack automata and Turing machines as models of computation with its own characteristics, which determine their applicability as tools for modeling computer problems.

   In addition, the students will state and explain the fundamental concepts of formal grammars and their relationship with the languages they generate. Linking formal languages with abstract automata, and use the structure of automata to study the structure of languages; and schedule one or more of the algorithms studied along the course.

   b) Prerequisite or co-requisites: 08276 – Discrete Mathematics.

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

    a) Specific outcomes of instruction:
    At the end of the course, the student will be competent in the use of the concepts and characteristics of formal languages and automata that recognize techniques, and some of it keys applications.

    b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
        a. Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level: apply (A)

7. Brief list of topics to be covered
    - Review and methods for demonstrating equivalence relations: Countable sets and uncountable sets.
    - Mealy and Moore automata.
    - Regular languages and finite automata.
    - Grammars and context-free languages. Stack automata.
    - Turing Machines.
    - Decidability.

1. **09551 – Databases**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Luis Eduardo Múnera

4. Text book title, author (s), and year:
   - Guillermo Londoño y Luis E. Múnera, *"Ingeniería del Software: Modelamiento de datos y eventos"*, Universidad Icesi, 1998.
   - Ricardo, Catherine, *" Bases de Datos",* Editorial McGraw-Hill, 2009
   - MaciasZek L.A., *"Database Design and Implementation",* Prentice Hall, 1990
   - Guillenson, Mark, *" Administración de Bases de datos",* Limusa Wiley 2006
   - Silberschatz A., Korth H., Sudarshan S., *"Fundamentos de Bases de Datos",* Quinta Edición, Editorial McGraw-Hill, 2006.
   - Luque I., Gòmez-Nieto M. A., Lòpez E., Cerruela G., *"Bases de Datos (Desde Chen hasta Codd con Oracle)"*, AlfaOmega, 2002.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   This is a theoretical and practical course on Relational Databases. Theoretical topics include database logical design and the use of formal languages, such as algebra and relational calculus; as well as management issues, related to database physical design. Practical topics include the usage of languages such as SQL and PL/SQL.

   b) Prerequisite or co-requisites: 09706 – Information Systems Modeling
   08276 – Discrete Mathematics

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
      - Develop a prototype of a database, according to a proposed logical design
      - Implement physical redesign of a database
      - Perform operations on a relational database, using SQL and PL/SQL as procedural languages.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level: apply (A)

- Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: apply (A)
- Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: apply (A)
- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: apply (A)

7. Brief list of topics to be covered
    - Fundamentals of database.
    - Query languages.
    - Logical Design.
    - Physical Design.
    - Procedural programming.

1. **09705 – Software engineering**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Hugo F. Arboleda

4. Text book title, author (s), and year
   - R. Pressman. Ingeniería del Software: Un Enfoque Práctico. 7Ed.McGraw Hill, 2010.
   - P. Bourque and R.E. Fairley, eds., Guide to the Software Engineering Body of Knowledge, Version 3.0, IEEE Computer Society, 2014; www.swebok.org.
   - C. Larman. UML y patrones. Prentice Hall, 2004.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   This course studies the main processes for software development, under continuous improvement and quality standards.

   b) Prerequisite or co-requisites: 09441 - Process Engineering
   09707 - Capstone project I

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course
   a) Specific outcomes of instruction:
   At the end of the course, the students will be able to: a) Recognize and explain the prescriptive and agile software development paradigms, b) Explain and execute processes encompassing software engineering, such as planning, configuration management and QA, c) Elicit, analyze and specify functional requirements; and design solutions using a UML-based approach, d) Evaluate compliance of designed software with given requirements, through unit tests.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: apply (A)
      - Outcome D: An ability to function on multidisciplinary teams. Level: teaching (T)

- Outcome H: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Level: teaching (T)
- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: apply (A)

7. Brief list of topics to be covered
    - Introduction to software engineering
    - Processes encompassing software engineering
    - Software requirements
    - Detailed Design
    - Software testing

1. **09711 – Computer Networks and Lab**

2. Credits (4) contact hours(4)

3. Instructor or course coordinator's name
   Dolly Maricela Gómez Santracruz

4. Text book title, author (s), and year:
   - *Redes de Comunicación*. León-García, Alberto y Widjaja Indra McGraw-Hill.
   - *Redes de Computadores*. Tanenbaum, Andrew. Prentice Hall. Quinta Edición

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   This course aims to show the student the importance of communications infrastructure, when developing an information system, or deploying a network service. Topics include the OSI reference model, and selected topics from the application, presentation, transport and connectivity levels. Concepts about infrastructure virtualization and campus network architectures are also treated.

   b) Prerequisite or co-requisites: 09687 - Algorithms and data structures

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
   After completing the course, students will be able to specify the performance requirements of applications and corporate network services, in order to design (in the case of campus networks) or specify (in the case of cloud-based services) the supporting communications infrastructure.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: teaching (T)
      - Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: apply (A)
      - Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: teaching (T)

7. Brief list of topics to be covered
    - Fundamentals.
    - Application level.
    - Presentation level.
    - Transport level.
    - Connectivity.
    - Infrastructure virtualization.
    - Campus network architectures.

1. **11121 – Digital Logic and Lab**

2. Credits (4) contact hours(4)

3. Instructor or course coordinator's name
   Daniel Dario Campo Ossa

4. Text book title, author (s), and year:
   - BROWN, Stephen y VRANESIC, Zvonko. Fundamentos de Lógica Digital con diseño VHDL. 2ª edición. México: McGraw-Hill, 2006
   - Diseño Digital. Principios y Aplicaciones. Wakerly, John., 3a edición, Prentice Hall, 2.001.
   - Roth, Charles H. Fundamentos de Diseño Lógico. 5ª Ed. Mexico: Thomson, 2005.
   - Marcoviotz, Alan B. Diseño Digital. 2ª ed. México: McGraw-Hill, 2005.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   The Digital Logic course is the application of mathematics in the engineering field, where first provides the basis of Boolean algebra applied to logic of digital systems. It is the basis of digital systems and implies the base of the Computer Structure studied in other courses. Among others, the axioms, theorems and conversions between number systems are reviewed. These are the basic combinational logic devices such as decoders, multiplexers, adders and comparators are treated. Besides an introduction to hardware description languages. The second part of the course includes basic sequential logic devices (flip-flops), and state machines. It has a practical component involves the design and implementation of digital systems to solve technological problems based on programmable logic devices.

   b) Prerequisite or co-requisites: 08276 – Discrete mathematics

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end, students will be able to understand and explain the functions of the digital hardware as base element for the implementation of systems that process, manipulate and store information. Also, describe the limitations of such digital systems. Designing and implementing digital circuits that provide solutions to technological problems of the environment, recursively applying appropriate design techniques and using CAD tools, programmable logic devices and interfaces with sensors and actuators.

b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
    - Outcome A: an ability to apply knowledge of mathematics, science, and engineering. Level: apply (A)

7. Brief list of topics to be covered
    - Digital Logic Families.
    - Information and Binary Number Systems.
    - Boolean Algebra and Logic Circuits.
    - Combinational Circuits and Building Blocks.
    - Sequential and Hardware Systems with Memory – FLIP – FLOPS.

Semester 7

1. **09331 – IT Project Management**

2. Credits (3) contact hours(3)

3. Instructor or course coordinator's name
   Walter Lucumí

4. Text book title, author (s), and year:
   - *Formulación y Evaluación de Proyectos.* Sexta Edición, Rafael Méndez Icontec Internacional.
   - PMP Exam Prep, Eighth Edition. Rita Mulcahy.
   - PMBOK Guide, 5th edition. PMI (Project Management Institute)

5. Specific course information

   a) Brief description of the content of the course (catalog description):
      - Be aware that definition and development of technology projects support the achievement of the organization's strategic goals.
      - Establish relationships between technology and general planning of an organization.
      - Describe and explain the importance of financial evaluation in project definition.
      - Evaluate the theories and techniques needed to successfully manage a project.
      - Apply the concepts of project management in the creation and development of his/her own company.

   b) Prerequisite or co-requisites: None.

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end of the course, the student will be able to assess the contribution of a systems engineer and / or telecommunications engineer to companies in the productive sector, through the application of project management concepts to all operational and administrative activities in their working environment.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome D: An ability to function on multidisciplinary teams. Level: apply (A)

- Outcome G: An ability to communicate effectively, orally and written, both in Spanish and English. Level: teaching (T)
- Outcome H: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Level: teaching (T)
- Outcome J: Knowledge of contemporary issues (i.e. ongoing issues where public interests are at stake). Level: teaching (T)

7. Brief list of topics to be covered
   - Strategic Planning.
   - Project Evaluation.
   - Project Management.

1. **09481 – Artificial Intelligence**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Luis Eduardo Múnera

4. Text book title, author (s), and year:
   - Múnera Luis Eduardo. "Principios de Inteligencia Artificial y Sistemas Expertos". Serie Textos Universitarios de la Icesi, No. 37.
   - David W. Rolston. "Principios de Inteligencia Artificial y Sistemas Expertos", Ed. McGraw-Hill, 1990.
   - Rauch-Hindin, Wendy B. "Artificial Intelligence in Business, Science, and Industry". 2 Vol. Prentice-Hall. 1986.

5. Specific course information

   a) Brief description of the content of the course (catalog description): This course is a hybrid between Artificial Intelligence and Expert Systems. AI techniques and strategies are presented; the course has an special emphasis on techniques supporting Expert Systems. Strategies for solving puzzle games are also presented.

      The course also discusses techniques for knowledge representation in expert systems, and approximate reasoning with emphasis on Fuzzy Logic.

   b) Prerequisite or co-requisites: 08276 – Discrete mathematics

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

a) Specific outcomes of instruction:
   The student will be able to analyze select problems in the AI field, propose a solution, and build prototypes or programs implementing solution strategies.

b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
   - Outcome A: An ability to apply knowledge of mathematics, science, as well as computing and software engineering. Level: apply (A)

7. Brief list of topics to be covered
    - Introduction to Artificial Intelligence and Expert System.
    - Problems and troubleshooting on artificial intelligence.
    - Knowledge representation based on Production Rules.
    - Knowledge representation based on Clausal Logic.
    - Knowledge representation based on Structured Objects.
    - Approximate Reasoning.

1. **09710 – Software architecture**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Gabriel Tamura

4. Text book title, author (s), and year:
   - Bass, Len, Paul Clements, Rick Kazman. Software Architecture in Practice. Addison Wesley, 2004.
   - Buschmann, Frank, Regine Meunier, Hans Rohnert, Meter Sommerland, Michael Stal. Pattern Oriented Software Architecture. John Wiley & Sons, 2001.
   - Gamma, Erich, Richard Helm, Ralph Johnson, John Vlissides. Design Patterns: Elements of Reusable Object-Oriented Software. Addison Wesley.
   - Jacobson, Ivar, Grady Booch, James Rumbaugh. El proceso unificado de desarrollo de software. Prentice Hall.

5. Specific course information
   a) Brief description of the content of the course (catalog description):
      This course studies the elements defining the structure and behavior of the software architecture, relationships that can occur between these elements are studied, their specification in UML.

   b) Prerequisite or co-requisites: 09705 – Software engineering.

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   a) Specific outcomes of instruction (ex. The student will be able to explain the significance of a current research, about a particular topic):
      After completing the course, the student will be able to design a software architecture that meets the most significant non-functional established requirements established.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints.
        Level: teaching (T)
      - Outcome F: An understanding of professional and ethical responsibility.
        Level: teaching (T)

- Outcome H: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Level: teaching (T)
- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: teaching (T)

7. Brief list of topics to be covered
    - The software architecture in the context of computer systems.
    - Analysis of architecturally significant requirements.
    - Reference models, patterns, and styles of architecture and design.

1. **09739 – Internet Computing**

2. Credits (2) contact hours(3)

3. Instructor or course coordinator's name
   Andres Felipe Paz Loboguerrero

4. Text book title, author (s), and year:
   - Elliotte R. Harold. Java Network Programming. O'Reilly Media, 4th edition, 2014.
   - Juan Diego Gauchat.El gran libro
     de HTML5, CSS3 y Javascript. Marcombo, 1ra edición, 2011.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
      This course studies the basic concepts and elements of the Internet, and its underlying standards and technologies, in order to develop applications.

   b) Prerequisite or co-requisites: 09711 - Computer Networks and lab

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   a) Specific outcomes of instruction:
      At the end of the course, the student will be able to: 1) Explain the design and operation of network applications. 2) Design and implement simple network applications. 3) Explain the design and operation of web applications. 4) Design and implement simple web applications.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: teaching (T)
      - Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level: teaching (T)

7. Brief list of topics to be covered
   - Network applications
   - Web applications
   - Front-ends for web applications
   - Front-ends for web applications with Java

1. **11313 – Computer Architecture and Lab**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Carlos Andrés Diaz Andrade

4. Text book title, author (s), and year:
   - *Computer Systems: A Programmer's Perspective,* Randal E. Bryant, David R. O'Hallaron. Addison Wesley Pub Co Inc; Edición: 0002 (1 de febrero de 2010).
   - *Digital Desing and Computer Architecture,* David Money Harris & Sarah L. Harris. Morgan Kaufmann; 1 edition (March 16, 2007)

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   The course of Computer Architecture will help students understand how the components of a computer work and allow they to recognize the capabilities and limitations of a computer system with a particular configuration and execution of the operations for which it is to use. It includes a study of the relation between hardware and software and general aspects of computer architecture such as: performance, Instruction Set Architecture, RISC and CISC CPUs, memory hierarchies, peripherals and storage devices as well as the use and application hardware platforms based on some commercial processors in order to solve certain technological problems in the field of engineering.

   b) Prerequisite or co-requisites: 11121 – Digital Logic and Lab.

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
   After completing the course, the student will be able to assess how the hardware structures and software components of a computer affect performance and utility of application programs in processing, storage and transportation of information.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
   - Outcome B: An ability to design and conduct experiments, as well as to analyze and interpret data. Level: apply (A)
   - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level: teaching (T)

7. Brief list of topics to be covered
    - Introduction to the structure of the computer.
    - Computer arithmetic (Representing and Manipulating Information).
    - Organization of a CPU and Architecture of Processors
    - Programming models for CISC and RISC processors.
    - Organization of memory and system input / output.
    - Computer system performance and techniques for Experimental design

Semester 8

1. **09635 – Graduation Project I**

2. Credits (3)

3. Instructor or course coordinator's name
   Norha Milena Villegas Machado

4. Text book title, author (s), and year: None

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   During this course, students complete their graduation project draft. The course provides tools to: i) identify and characterize an engineering and/or research problem within a context; ii) seek references allowing the student to define the framework and the state of the art associated with the problem; iii) define and manage a project plan, and propose a methodology developing the project; iv) develop and strengthen oral and written communication skills.

   b) Prerequisite or co-requisites: 09710 – Software architecture (SSE)
   09331 – IT Project Management

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course
   a) Specific outcomes of instruction:
   At the end of the semester, the student will be able to:
   - Formulate an engineering or research problem
   - Formulate the project's objectives (general and specific).
   - Describe and evaluate the theoretical foundations, techniques and former developments that contribute to the solution of the problem.
   - Propose a methodology to solve the problem, identifying contributions and expected results, and considering resource and time constraints.
   - Write the graduation project draft, and present it effectively

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
   - Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: apply (A)
   - Outcome F: An understanding of professional and ethical responsibility. Level: teaching (T)
   - Outcome G: An ability to communicate effectively, orally and written, both in Spanish and English. Level apply (A)

- Outcome H: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Level: apply (A)
- Outcome I: Recognition of the need for, and an ability to engage in life-long learning. Level: apply (A)

7. Brief list of topics to be covered
    - Problem Definition and objectives.
    - Theoretical framework and State of the Art.
    - Contributions and Methodology.
    - Project development

1. **09713 – Capstone Project II**

2. Credits (3) contact hours(4)

3. Instructor or course coordinator's name
   Gabriel Tamura.

4. Text book title, author (s), and year:
   - Sommerville, Ian. Software Engineering. 8 Ed. Addison Wesley, 2006.
   - Pressman, Roger. Ingeniería del Software: Un Enfoque Práctico. 8 Ed. Prentice Hall, 2006.
   - Thayer, Richard. Software Engineering Project Management Tutorial. IEEE. Thayer, Richard, Merlin Dorfman. Software Requirements Engineering. IEEE

5. Specific course information
   a) Brief description of the content of the course (catalog description):
   This course synthesizes and applies software development concepts from previous semesters. Students form teams to execute a software project, following a recognized software development life cycle, and using pertinent methodologies in each phase.

   b) Prerequisite or co-requisites: 09710 – Software architecture.
   09331 – IT Project Management
   09551 – Databases.

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course
   a) Specific outcomes of instruction:
   After completing the course, the student will be able to integrate the skills acquired in the different courses of the Software Systems Engineering Program, for developing software applications as a member of a group of software developers.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome C: An ability to design software systems, components, and processes to meet established requirements within realistic economic, environmental, social, political, ethical, health and safety, and sustainability constraints. Level apply (A)
      - Outcome D: An ability to function on multidisciplinary teams. Level apply (A)
      - Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level apply (A)
      - Outcome F: An understanding of professional and ethical responsibility. Level teaching (T)

- Outcome H: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Level apply (A)
- Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level apply (A)

7. Brief list of topics to be covered
    - Conceiving and planning the software development project
    - Requirement elicitation, analysis, specification, verification and validation.
    - Software system architecture and data model.
    - Control and presentation logic.
    - Integration, testing and deployment.

Semester 9

1. **09621 – Graduation Project II**

2. Credits (3)

3. Instructor or course coordinator's name
   Gonzalo Vicente Ulloa Villegas

4. Text book title, author (s), and year: None

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   During this course, students complete their graduation project. Responsibility is shared among the students, their project mentor, and the course coordinator.

   In their work plan, students schedule meetings with their mentor to: assess project progress, and resolve difficulties that may arise. Students should also attend five project-monitoring meetings with the course coordinator. These meetings allow students to: a) socialize their work and results; b) check project progress; c) identify potential difficulties; d) receive additional counseling regarding the achievement of objectives, and e) receive advice regarding the project final presentation.

   b) Prerequisite or co-requisites: 09635 - Graduation Project I.

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required

6. Specific goals for the course

   a) Specific outcomes of instruction:
   After completing the course, students must have had the opportunity to reflect on the following values and work on the development of the following skills:
   - Responsibility, timely fulfillment of tasks and responsibilities
   - Capacity for analysis and conceptualization, through the identification of the necessary elements to solve a proposed problem.
   - Communication skills.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
   - Outcome E: An ability to identify, formulate, and solve problems through the application of computing and software engineering. Level: apply (A)
   - Outcome F: An understanding of professional and ethical responsibility. Level: teaching (T)

- Outcome G: An ability to communicate effectively, orally and written, both in Spanish and English. Level: apply (A)
- Outcome H: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Level: apply (A)
- Outcome J: Knowledge of contemporary issues (i.e. ongoing issues where public interests are at stake). Level: apply (A)

7. Brief list of topics to be covered

   Not applicable. There are no specific topics covered, since the intent of the course is to advise students in the development of their graduation projects.

1. **09714 – Principles of Information security**

2. Credits (3) contact hours (3).

3. Instructor or course coordinator's name
   Juan Manuel Madrid.

4. Text book title, author (s), and year:
   - International Organization for Standardization – ISO. ISO/IEC 27002:2013 standard.
   - Charlie Kaufman, Radia Perlman y Mike Speciner. Network Security: Private Communication in a Public World. Prentice Hall PTR, 1995.
   - Michael Whitman y Herbert Mattord. Principles of Information Security. Course Technology, 2009.
   - Software Engineering Institute. The CERT Oracle Secure Coding Standard for Java. Pearson, 2011.

5. Specific course information

   a) Brief description of the content of the course (catalog description):
   This is an introductory course in information security. It studies basic information security concepts and tools, using the ISO 27002:2013 standard as a framework.

   b) Prerequisite or co-requisites: 09711 – Computer Networks and Lab (for SYS)
   09654 – Computer Networks I (for TE)

   c) Indicate whether it is a Required, Elective or Selected Elective (as per Table 1-1) course, in the program: Required.

6. Specific goals for the course

   a) Specific outcomes of instruction:
   At the end of the semester, the student will be able to: explain the purpose of the main domains of the ISO 27002:2013 standard, and to implement security services in those domains.

   b) Explicitly indicate which of the student outcomes, listed in Criterion 3 or any other outcomes, are addressed by the course:
      - Outcome K: An ability to use the techniques, skills, and modern engineering tools necessary for the computing and software engineering practice. Level apply (A)

7. Brief list of topics to be covered
   - Introduction to information security.
   - Cryptography.

- Physical and environmental security.
- Access control and authentication.
- Security in operations - security from the hacker’s point of view.
- Security in telecommunications.
- Acquisition, development and maintenance of information systems - Secure coding in Java.