COURSE SYLLABI

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1st Semester

1. **Course number and name**
   Catalogue Number: 70020
   Basic Idiomatic Skills

2. **Credits and contact hours**
   Credits: 2 Attendance hours: 3 per week - Autonomous work: 3 per week

3. **Text book, title, author, and year**
   - Creme Phyllis y Mary, Lea R. Escribir en la universidad. Barcelona. Gedisa. 2000.
   - G. de Montes, Zoraida y Montes, Laura. Mapas mentales paso a paso. México: Alfaomega, 2003.
   - Instituto Cervantes. Saber escribir. Bogotá: Aguilar, 2007.
   - Martín Vivaldi, Gonzalo. Curso de redacción: teoría y práctica de la composición y del estilo. Madrid: Paraninfo, 2000.
   - Nueva gramática de la lengua española. Manual. Bogotá: Espasa, 2010.
   - Ortografía básica de la lengua española. Bogotá: Real Academia Española-Espasa, 2012.
   - Perelman, Chaïm y Olbrechts-Tyteca, Lucille. Tratado de la argumentación. La Nueva Retórica. Madrid: Gredos, 1989.
   - Robinson, Ken y Lou Aronica. El elemento. Madrid: DeBolsillo, 2011.

4. **Specific course information**
   a. The purpose of this course is train students in the knowledge of the native language as a basic tool to develop reading, writing and oral skills that will help strengthen their critical thinking.
   b. No pre-requisites
   c. Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction
      - Identify university reading as a cognitive process, develop planning strategies for academic writing and plan and elaborate oral speeches.
      - Reinforce grammar and spelling of the Spanish language.
      - Improve the ability to navigate and consult electronic media.
      - Incorporate skills in the handling of computer tools applied to the reading and writing processes.
      - Perform academic activities agreed with the teacher for the development of basic language skills.

   a. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

- (g) An ability to communicate effectively.

6. Brief list of topics to be covered

1. Reading and knowledge.
   - Reading as a form of access to knowledge.
   - Aesthetic reading.
   - Reader process.
   - Inferential reading and critical reading.
   - Reading workshops and practical application of the reading process
   - Inferential reading workshop
   - Critical reading workshop
2. Writing process
   - The grammar of the Castilian language: morphology and syntax.
   - Organization and textual creation
   - Planning. Elaboration of the draft.
   - Review and edit. Punctuation use and application signs.
   - Argumentative writing workshops.
   - Elaboration of an argumentative text. Critical elucidation of the argumentative text.
3. Assertive communication
   - Active listening
   - The dialogue
   - The pragmatics of dialogue
   - Oral presentation
   - Workshops of critical listening of academic discourse
   - Workshops of academic speech. Guidance and oral support of academic discourse.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue Number: 80116
   Differential calculus

2. **Credits and contact hours**
   Credits: 3. Attendance hours: 5 per week. Autonomous work: 4 per week

3. **Text book, title, author, and year**
   - Stewart James. Calculus of a variable, early transcendental. Cengage Learning México. 2012
   - Thomas George. Calculus of a variable. Pearson Education. Mexico .2010.
   - Piskunov Nikolai. Differential and Integral Calculus. Noriega Publishers Group. México.1993.

   Supplemental materials
   - Haeussler Ernest. Math for administration and economics. Pearson Prentice Hall. México .2008.
   - Purcell Edwin. Differential and Integral Calculus. Pearson Education. México 2007.

4. **Specific course information**
   a. The purpose of this course is to give students the knowledge and fundamental concepts of single variable and several skills allowing them to work with the concepts.
   b. No prerequisites
   c. Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction
      This course requires previous knowledge of algebra and trigonometry of high school. Upon completion of this course, students will be able to:
      - Draw functions of single variable to determine domain, range, asymptotes, growth and/or decay intervals and concavity.
      - Apply the concepts of average rate, instantaneous average, related rate and optimization to specific problems and other contexts.

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

6. **Brief list of topics to be covered**
   1. Functions and Models.
      - Four Ways to represent a Function
      - Mathematical Models: A catalog of Essential Functions
      - New Functions from old Functions
      - Graphing Calculators and Computers

- Exponential Functions
- Inverse Functions and Logarithms

2. Limits and Derivatives
   - The Tangent and Velocity Problems
   - The Limit of a function
   - Calculating Limits Using the Limit Laws
   - The precise Definition of a Limit
   - Continuity
   - Limits at Infinity; Horizontal Asymptotes
   - Tangents, Velocities, and other Rates of Change
   - Derivatives
   - The Derivative as a Function
3. . Differentiation Rules
   - Derivatives of polynomials and Exponential Functions
   - The Product and Quotient Rules
   - Rates of Change in the Natural and Social Sciences
   - Derivatives of trigonometric Functions
   - The Chain Rule
   - Implicit Differentiation
   - Higher Derivatives
   - Derivatives of Logarithmic Functions
   - Hyperbolic Functions
   - Related Rates
   - Linear approximations and Differentials.
4. Applications Of Differentiation
   - Maximum and Minimum Values
   - The Mean Value Theorem
   - Hoe Derivatives Affect the Shape of a Graph
   - Indeterminate Forms and L´ Hospital´s Rule
   - Summary Of Curve Sketching
   - Optimization Problems

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 21102
   General Chemistry I

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 5, Individual work hours: 4

3. **Text book, title, author, and year**
   - BROWN, T., LeMAYT, H.E. y BURSTEN, B., 2004, Chemistry, The Central Science, 9ª Ed., Ed. Prentice Hall, México.
   - CHANG, R., 2007, Chemistry, 9ª Ed., Ed. Mac Graw Hill, China.

   Supplemental materials
   - WHITTEN, K., DAVIS, R. y PECK, M., 2008, General Chemistry, 8ª Ed., Ed. Mac Graw Hill, Madrid.
   - KOTZ, J.C. y TREICHEL, P.M., 2005, Chemistry and Chemical Reactivity, 6a Edition, Ed. Thomson, México.
   - PETRUCCI, R. y HARWOOD, W., 1999, General Chemistry, 7ª Ed., Ed. Prentice may Iberia, Madrid.
   - BRICEÑO, C.O. y RODRIGUEZ DE CACERES, L., 1999, Chemistry, 2ª Ed., Fondo Educativo Panamericano, Bogotá.
   - EBBING, D.D. y GAMMON S.D. 2010, General Chemistry, 9ª Ed., Cengage Learning, México.

4. **Specific course information**
   a. One of the professional strengths of an engineer is the panoramic view that allows him to observe the different factors related to a situation and analyze them critically to make adequate and well-argued proposals. The basic scientific basis allows the professional to understand the natural environment and brings it closer to scientific and technological development. This subject provides the basis for understanding the physical behavior of materials; knowing the atomic and molecular structure of matter can understand the interactions between different particles that cause the different states of aggregation of substances and the possibility of mixing with each other.

   b. No Prerequisites

   c. Required

5. **Specific goals for the course**

a. Specific outcomes of instruction:
   - Awaken curiosity and intellectual restlessness for everything that surrounds us.
   - Develop reading and writing skills (in text, tables and graphs) in the context of this science.
   - Know the basic physical principles that explain the behavior of materials and allow understanding the environment.
   - Develop ability to relate variables.
   - Apply, in the topics covered in the program, the mathematical concept of proportions, developing skills for its management.
   - Encourage students to develop an abstract thinking, with the ability to relate it to concrete thinking.
   - Recognize the dynamism of science and technology, understanding the important role of research in its development.
   - Promote the development of a logical and critical thinking in the analysis and interpretation of problematic situations and in the proposal of solutions to them with good arguments.
   - Create habits that help take responsibility for the study.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   - a - Applies knowledge of science, mathematics and engineering

6. Brief list of topics to be covered

- Measurements, International System of Units and precision and accuracy of measurements
- Fundamental concepts on matter and energy
- Atomic and molecular structures
- Concept of mol
- Physical behavior of materials: intermolecular forces
- Changes in condition: solid, liquid and gaseous
- Homogeneous mixtures. Solutions and colloids

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue Number: 80062
   Introduction to Engineering

2. **Credits and contact hours**
   Credits: 2. Attendance hours: 2 per week. Autonomous work: 4 per week

3. **Text book, title, author, and year**
   - Thinking like an Engineer: An Active Learning Approach by E. A. Stephan, D. R. Bowman, W. J. Park, B. L. Sill, and M. W. Ohland (Prentice Hall, 2011 /ISBN-13: 978-0-13-606442-8

   Supplemental materials
   - Supplementary course material is available at Virtual Sabana -Online system (http://virtual.unisabana.edu.co/course/view) for students registered for the course

4. **Specific course information**
   a. This course provides an introduction to the engineering profession. Information on the different disciplines of engineering will be presented. Professional and ethical aspects of engineering are covered. An introduction to problem solving and the engineering design process.

   b. No Prerequisites

   c. Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction.
      - To prepare students for the rigor of future engineering classes
      - To provide students with a solid foundation of basic engineering skills
      - To introduce students to the different engineering majors and career options

   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      - (c) ability to design a system or component, under realistic constraints
      - (d) An ability to function on multidisciplinary teams.
      - (e) An ability to identify, formulate, and solve engineering problems.

6. **Brief list of topics to be covered**
   - Differences between the various fields of engineering specialization.
     - Identify future career paths and job opportunities as related to the Engineering profession.

   - Design Process
     - How might we create the best possible solution to a problem?

- What is the most effective way to generate potential solutions to a problem?
- How many alternate solutions should you generate?
- What are the most pressing engineering/technical problems of our time?
- What is an engineer? What types of work do engineers do?

- Describe the moral foundations of Engineering Ethics.
  - List some of the basic tenets of the Codes of Engineering Ethics.
  - Discuss case studies as applied to Engineering.

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Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue number: 1502101
   Chemical Engineering Workshop

2. **Credits and contact hours**
   Credits: 2. Attendance hours: 2 per week. Autonomous work: 4 per week

3. **Text book, title, author, and year**
   - Basic Principles and Calculations in Chemical Engineering / David Mantner Himmelblau; tr. Roberto Lui
   - Introduction to chemical processes: Principles, analysis, synthesis. Regina M. Murphy, 2007

4. **Specific course information**
   a. Recognize the importance of scientific knowledge as a basis for solving engineering problems. Establish a structured method for solving various problems in Chemical Engineering. Properly use block diagrams to represent processes in the chemical industry. Present adequately the technical reports in which the problem presents, the method (s) used in its solution, the data, the answers and the conclusions that gave rise to it. Structure a method for the design of processes with chemical reaction.
   b. No prerequisites
   c. Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction
      This course requires previous knowledge on basic statistics and operation management. Upon completion of this course, students will be able to function on teams to model systems with stochastic characteristics, then the students will be able to:
      - Design experiments: collect, choose and process data, using statistical tools.
      - Apply the steps of a simulation study.
      - Build models using specialized software.
      - Evaluate alternatives and interpret the statistical analysis results to take decisions.

   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      - (c) Ability to design a system
      - (d) Ability to work in groups
      - (i) Continuous self-learning
      - (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

6. **Brief list of topics to be covered**

- Characterization of the product to be stored. Identification of the physicochemical properties necessary to carry out the design of the storage system. Identification of risks to health, the environment, and industrial safety. Industrial applications, procurement. Deliverable: Product Description and storage capacity.
- Location of the plant, Identification of the areas that will make up the storage system.
- Storage system plans, integration between areas, control systems, administrative, security and logistics.
- Review the information collected on the storage system and research of industrial processes for the chemical synthesis of the assigned compound
- Each team will design 3 options to synthesize the assigned compound using theoretical bases of inorganic and organic chemistry. For each process they will construct the generation matrix - consumption
- From the selected process, additional tasks will be assigned to increase the process complexity until a chemical process involving 2 to 3 chemical reactions is obtained. With this process, students will generate the new consumption generation matrix and design the block diagram for that process
- Each working group will investigate the different types of industrial equipment that operate as separators, mixers and reactors, to define what type, based on the physical state of their compounds, are useful for their process.
- Review and simplify process diagrams of each team. Draw of new team members. Feedback on teamwork. delivery schedules of the 3rd court
- Beginning of the development of the material balance of each team with the final block diagram: Reaction of reaction balances, molecular weight calculations, verification of the purity information of the reagents, definition of the phases in which each compound is found in each stream in the diagram
- Finalization of the material balance of the process performed for fixed conditions of the process, by hand

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue number: 120015
   Basic Digitals Skills

2. **Credits and contact hours**
   Credits: 3. Attendance hours: 3 per week. Autonomous work: 6 per week

3. **Text book, title, author, and year**
   - Brillo: así es el sistema operativo de Google para el Internet de las cosas (2015). Recuperado de http://www.xataka.com/internet-of-things/brillo-asi-es-el-sistema-operativo-de-google-para-el-internet-de-las-cosas
   - Intel. (2014). Internet of Things Video: IoT Explained. Recuperado de http://www.intel.es/content/www/es/es/internet-of-things/videos/what-is-the-internet-of-things.html
   - Universidad de Deusto. (2011). Internet de las Cosas. Recuperado de https://www.youtube.com/watch?v=542oTWpKPlE
   - Ministerio de las TIC. (s.f). Ciudades inteligentes. Recuperado de http://estrategiaticolombia.co/ciudadesinteligentes/#competitividad---convivencia o http://www.eduteka.org/modulos/1/8/2118/1
   - History Channel. (2014). Robótica, Documental. Recuperado de https://www.youtube.com/watch?v=3ZjpMg_UzIQ
   - Eduteka. (2014). Bitácora de evaluación. http://www.eduteka.org/glosario/tiki-index.php?page=Bit%C3%A1cora+de+evaluaci%C3%B3n

   Supplemental materials
   - Cárdenas, M. (2014). Video 1 - Competencias en manejo de información – Mahara. https://www.youtube.com/watch?v=UPIF6qkXr08
   - Cárdenas, M. (2014). Video 2 - Competencias en manejo de información – Mahara. https://www.youtube.com/watch?v=UPIF6qkXr08

4. **Specific course information**
   a. The purpose of this course is to give students the knowledge and fundamental concepts that are part of the digital competition proposed by the University.
   b. No Prerequisites
   c. Required

5. **Specific goals for the course**
   a. Specific outcomes of instruction
      - Explains the different elements of knowledge products.
      - Reuses knowledge products and generates new uses and representations.
      - Designs, plans and evaluates collaborative work strategies that allow him / her to meet the proposed objectives.
      - Recognizes when and how to use technology of information and communication in academic settings.
      - Promotes and practices the intellectual property statute guidelines.

- Develops an intuitive use of computer tools, and adapts easily to the changes that occur in them.
- Choose the most appropriate technological tools to fulfill the proposed objectives.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   - (k) ability to use modern engineering tools

6. Brief list of topics to be covered

- Type of Societies through mental maps.
- Introduction to the current Trends in technology of information and communication.
- Formulation of good quality questions to guide the search of information.
- Use of databases.
- Planning of projects mediated by technology of information and communication.
- Application of criteria for evaluation of information.
- APA reference standards.
- Copyright (CR, CL, CC).
- Fundamentals of Multimedia, fundamentals of design, color theory and typography.
- Reality and Virtual Reality

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue number: 21104
   Introduction to CAD

2. **Credits and contact hours**
   Credits: 2. Working hours: 3. Individual work hours: 3

3. **Text book, title, author, and year**
   - Schaum´s Outlines Descriptive Geometry; Hawk, M. C.; Mc Graw Hill; New York; 1962.
   - Geometría Descriptiva; Wellman, B. L.; Editorial Reverte S. A.; Barcelona; 1987.
   - Aprender AutoCAD 2015 con 100 ejercicios prácticos; Alfa Omega; Barcelona; 2015.
   - AutoCAD 2002 Avanazado; Tajadura Zapirain, J.A. y Lopez Fernandez, J.; Mc Graw Hill; Madrid; 2002.
   - Inventor y su simulación con ejercicios prácticos; Younis, W.; AlfaOmega; México; 2013.

   Supplemental materials
   - Web page Virtual sabana: http://virtual.unisabana.edu.co/course/view.php?id=9390
   - Blog : https://introduccionalcad.blogspot.com.co/

4. **Specific course information**
   b. The purpose of this course is to give the students concepts and technological tools for them to be able to make a graphical representation, which is a very important issue in the communication between engineers.
   c. No prerequisites
   d. Required

5. **Specific goals for the course**
   a. Specific outcomes of instruction:
      - The student will be able to understand and manage the graphical representations in two and three dimensions.
      - The students will have the ability to develop their engineering careers with the use of specialized software in order for them to create any type of representations.
      - The students will be able to interpret graphical representations in different scales.

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

6. **Brief list of topics to be covered**
   Chapter 1.
      - Descriptive geometry

- Introduction (to geometry and descriptive geometry)
- Projection af a point
- Projection of a line
- Projection of a plane
- Course, slope, real magnitude
- Intersections (line-plane, plane-plane)
- Special projections
- Rotations
- Geometric bodies

Chapter 2. Introduction to AutoCAD Software

- Introduction (GUI, keyboard manage, among others)
- Object construction (Commands, coordinates, types of lines)
- Edition and organization (modifications, colors, layers)
- Bounded and dimensions.
- 3D Representations

Chapter 3. Introduction to Autodesk Inventor Professional software

- Creation of projects
- Pieces module
- Assembly module
- Presentation module
- Blueprints module
- Render module
- Animation module

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2nd Semester

1. **Course number and name**
   Catalogue Number: 578001
   Core Curriculum Person and Culture I.

2. **Credits and contact hours**
   Credits: 2. Attendance hours: 2 per week. Autonomous work: 2 per week

3. **Text book, title, author, and year**
   - Yepes Stork, R., Aranguren Echavarría, J. (2009). Fundamentos de antropología filosófica: un ideal de la excelencia humana. 6ª ED. España: Eunsa. ISBN 13: 9788431316228 / Cap. 1, págs.. 21-27.
   - Bicocca, M. (2011) La persona humana y su formación en Antonio Millán-Puelles. Pamplona: Editorial Eunsa. Cap. 4, págs. 102-113. ISBN: 9788431328238
   - Sélles Dauder, J. F. (2006) Antropología para inconformes. 3ª ED. España: Rialp. ISBN: 9788432135965
   - Aristóteles. (2009) Ética a Nicómaco. Madrid: Centro de Estudios Políticos y Constitucionales. ISBN: 9788425909559
   - Isaacs, D. (2010) La educación de las virtudes humanas. 15ªED. Pamplona: Eunsa. Ediciones Universidad de Navarra. ISBN: 9788431327040
   - Gaja Jaumeandreu, R. (2015) Bienestar, autoestima y felicidad. Bacelona: Penguin Random House Grupo Editorial. 6ªED. ISBN: 9788499086323

4. **Specific course information**
   a. The purpose of this course is encouraging in the student the reflection on the aspects that constitute the human nature and the personal being and that reaches a theoretical synthesis in the respect.
   b. No Prerequisites
   c. Required.

5. **Specific goals for the course**
   a. Upon completion of this course, students will be able to:
      - Evidences the integration of the human faculties in their corporal base and that identifies the aspects according to which the corporal dimension transcends.
      - Understands the characteristics of maturity proper to his chronological age.
      - Identify the behaviors that manifest a high self-esteem.
      - Develop a critical and realistic thinking about the balance between their qualities and defects.
      - Identify freedom as a capacity for self-determination to act and the limits of human freedom.
      - Discover happiness as the universal aspiration of human beings and their relationship to love and fullness of life possible.
      - Recognize the need to cultivate an appropriate emotional climate in family relationships.

- Identify the characteristics of human care practiced in the home.
- Choose the most appropriate technological tools to fulfill the proposed objectives.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   - (f) An understanding of professional and ethical responsibility.

6. Brief list of topics to be covered

- Identity and self-esteem
- Close relations
- Human perfection processes in the family
- Family values
- Friendship

Universidad de La Sabana
Course Syllabi
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1. **Course number and name:**
   Catalogue Number: 62133
   English Level 3

2. **Credits and contact hours:**
   Credits: 3 Contact hours: 4 Individual work hours: 4

3. **Text book, title, author, and year**
   - Atwell, N. (2002). Lessons that change writers. United States: Heinemann.
   - Barker, H, Cunningham, S & Moor, P. (2008). New Cutting Edge Pre-intermediate. (5th ed.). China: Pearson Education Limited.
   - Clare, A & Wilson, J. (2013). Speakout Pre-intermediate. (7th ed.). Slovakia: Pearson Education Limited.
   - Davis, R. (1998 - 2015). Esl-labcom. Retrieved August, 2015, from http://www.esl-lab.com/
   - McGraw-Hill, (Ed). (2010). Writer's Choice. (1st ed.). Columbus: McGraw-Hill.
   - Soars, J & Soars, L. (2004). New Headway Pre-intermediate. (4th ed.). England: Oxford University Press.

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)
      Students will read and show understanding of written texts related to relationships, jobs, education, tourism and health. Similarly, they will listen to recordings and talks about motivations in certain companies, job interview, life decisions, talents, tourism, and will show their understanding through different activities. Students will write paragraphs with appropriate sentence structures regarding work experience, work-life balance, talents and trips. Students will orally describe and give opinions about their personal life style, happiness, their majors, their own and other people's talents, tourism and health. The students will use learning strategies and self-monitoring to become responsible for their own learning. Finally, students will use Communication Technologies (ICT) to support their learning processes.

   b. Prerequisites: 62132 English 2 if English prerequisite not waived
   c.
   d. Required

5. **Specific goals for the course**
   Speaking. the student can: start and end a conversation about his/her personal feelings and emotions. • talk about his personal life as well as others´. • discuss likes and dislikes responding and asking more questions to keep the conversation going. • describe different kind of jobs. • use appropriate grammar structures and language of negotiation. • avoid hesitation, pronounce and intonate without interfering with communication. discuss and exchange information about tourism.

Writing. The student can: • use a variety of connectors and linking words to make the written composition easy to read. • include simple and present perfect structures in the paragraph. • write about things they like and dislike. write an application form.
Listening The student can: • identify the general and specific details in the spoken discourse. • identify general and specific information from academic recordings.
• understand the main points of a variety of recordings when people talk about their jobs and talents. • show understanding by completing multiple choice exercises.
Reading: The student can: • read and show understanding of written discourse taken from different resources. • identify main and specific ideas from academic texts. • recognize the general line of argument in a text but not necessarily in detail. • understand articles and reports concerned with contemporary problems in which the writers adopt particular stances and/or viewpoints. • identify and obtain the general and specific details in the discourse. • identify the main conclusions in clearly signaled opinion texts. • identify thesis statements from academic texts.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   - g. An ability to communicate effectively

6. Brief list of topics to be covered

- Topics: Life, Work and Time out.
- Vocabulary related to: Free time, relationships, collocations, jobs, work, holidays, likes and dislikes, activities to keep balance.
- Grammar structures: Verb tenses revision: simple past, simple present, present continuous, future with will and be going to; adverbs of frequency, verb patterns for expressing likes and dislikes. Second Term
  Topics: Great Minds, Travelling and Fitness.
- Vocabulary related to: Travel items,talents, education, journeys, health, food and superfoods.
- Grammar structures: Present perfect vs. simple past/ can (possibility), have to, must, should/ , make vs do, simple past vs past continuous, verb patterns.

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Chemical Engineering

1. **Course number and name**
   Catalogue number: 80114
   Integral Calculus

2. **Credits and contact hours**
   Credits: 3 Contact hours: 4 per week. Autonomous work: 5 per week

3. **Text book, title, author, and year**
   - J. STEWART calculus in a variable, Edition 7, Early Trascendentals (Vol 1) Cengage Learning. México. 2012
   - R. Cano Integral Calculus, Second Edition. University of the Sabana. Colombia.2017.
   - G. B. Thomas, R.L .FINNEY , M.D. WEIR Calculus with analytical Geometry. Addison – Wesley. 1999.

a. other supplemental materials
   - Edwards, PENNEY Calculus with analytical Geometry. Addison –Wesley. 1999.
   - S.L SALAS, E. HILLE Calculus of one several Variables with analytical Geometry. Reverts 200.

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
      The purpose of this course is to give students the knowledge for integration of functions of one variable, with applications. The course includes the representation of functions by Taylor in single variable.

   b. Prerequisites or co-requisites: 80116 Differential calculus.

   c. Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction, ex.
      This course requires previous knowledge on differential calculus. Upon completion of this course, students will be able to:
      - Calculate areas using Riemann's sums and/or the fundamental theorem of calculus.
      - Apply the concept of integration to calculate areas between curves, curve length, volume of a revolution solid and applications.
      - Determine the convergence value of a series or determine whether it is convergent or divergent.
      - Apply function representation using Taylor series to approximate the calculation of defined integrals.

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

- (a) an ability to apply knowledge of mathematics, science, and engineering

6. **Brief list of topics to be covered**
   1. Integration
      - Antiderivatives
      - Notation
      - Areas and estimation using finite sums
      - Definite integral definition
      - Fundamental Theorem of Calculus
      - Indefinite integrals
   2. Methods of integration
      - Method of substitution
      - Integration by parts
      - Trigonometric integrals
      - Trigonometric substitution
      - Partial fractions
      - Improper integrals
   3. Applications
      - Area between curves
      - Volumes and areas of revolution
      - Volumes and areas of revolution
      - Curve length
      - Courses in economics
      - Integral in physics and engineering
   4. Sequences and series.
      - Successions
      - Series
      - Criterion of integral
      - Comparison criterion
      - Criterion of reason and root n -ésima
      - Alternating series
      - Power series
      - Taylor series and maclaurin series

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1. **Course number and name**
   Catalogue Number: 80101
   Linear Algebra

2. **Credits and contact hours**
   Credits: 3 Attendance hours: 4 per week. Autonomous work: 5 per week

3. **Text book, title, author, and year**
   - Grossman, Stanley. Linear Algebra. Sixth Edition. Mc Graw Hill. Mexico, 2008.
   - Kolman, Bernard. Linear Algebra with MATLAB applications. Pearson Education of Colombia, 1999.
   - Lang Serge. Linear Algebra. Third Edition. Springer. New York .1987.

   a. other supplemental materials
   - Strang, Gilbert. Introduction to linear Algebra. Fifth Edition. Wellesley Cambridge Press. United States.2016.

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
   The purpose of this course is to give students the knowledge of matrix theory, linear algebra, systems of linear equations and the properties of matrices.

   b. prerequisites or co-requisites. Not required.

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction, ex.
   This course requires previous knowledge of algebra and trigonometry of high school. Upon completion of this course, students will be able to:
   - Solve problems using systems of linear equations.
   - Calculate equations of lines, planes, areas of parallelograms and volumes of parallelepipeds by relating them to vectors in two and three dimensions.
   - Use the matrix representation of a linear transformation associating concepts such as rank, nullity and dimension.
   - Apply the concepts of eigenvalue and eigenvector to obtain the diagonal representation of a matrix.

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

6. **Brief list of topics to be covered**

1. **Linear Equations and Matrices System**
   - Matrices
   - Matrix operations
   - Matrices and systems of linear equations.
   - Elimination of Gauss-Jordan
   - Inverse of a square matrix.
   - Matrix transposed
2. **Determinants**
   - Definitions
   - Properties of the determinant.
   - Inverse of a square matrix.
   - Matrix transposed
3. **Vectors in two and three dimensions**
4. **Vectors in the plane and in space.**
   - Scalar product and projections
   - Cross product.
   - Equation of lines and planes in R3
5. **Vector Spaces**
   - Definition and basic properties.
   - Vector subspaces.
   - Linear combination and generated space.
   - Linear independence.
   - Bases and dimension.
   - Range and nullity
6. **Linear Transformations**
   - Defintion and examples.
   - Matrix representation.
7. **Diagonalization**
   - Eigenvalues and eigenvectors associated with a matrix.
   - Similar matrices and diagonalization.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Number: 21204
   General Chemistry II

2. **Credits and contact hours:**
   Credits: 4, Contact hours: 4, Laboratory hours: 3, Individual work hours: 5

3. **Text book, title, author, and year**
   - Química, Chang Raymond, 2010

   Other supplemental materials
   - Química, La ciencia central. Brown, Theodore L.; LeMay, H. Eugene Jr.; Bursten, Bruce E.; Murphy Catherine J.; Woodward, Patrick M.2012
   - Química General. Petrucci, Ralph H.; Harwood, William S.; Herring, F. Geoffrey. 2003
   - Química y Reactividad Química. Kotz, J.C.; Treichel, P.M. 2003
   - Química General. Whitten, K.; Davis, R.; Peck, M.1998

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)
      It is a theoretical-practical course in which students build their basic knowledge about reactivity and their relationship with the chemical structure The conceptions of the students is developing in a similar way to how the scientific concepts were developed; in this way they seek to understand that science and technology are dynamic and that the knowledge they build on them cannot be static, but they must be kept in permanent updating and restructuring. It is aimed at students of chemical engineering and agro-industrial production engineering who require chemistry to build scientific and technological knowledge for their professional performance.

   b. Prerequisites: 21102 – General Chemistry I

   c. Required

5. **Specific goals for the course**
   a. Specific outcomes of instruction
   The student will be able to:
   - Understand the different transformations of the matter through the use of chemical equations.
   - Analyze and understand the different states associated with de chemical equilibrium of reactions in aqueous solutions and/or gases to determine the viability of a process according to its experimental conditions.

- Inquire about phenomena related to precipitation and acid-base properties of general use substances in a chemistry laboratory.
- Understand the relationship between chemical energy and electrical energy through the use of reactions as a source of an electric potential usable in a process.
- Analyze experimental variables involved in a chemical reaction as determinants in the rate of a chemical process.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
- a - Applies knowledge of science, mathematics and engineering
- b – Ability to design and conduct experiments

6. Brief list of topics to be covered

- Chemical reactions
- Balance of chemical equations and stoichiometry
- Limiting Reagents. Reaction Yield.
- Purity of reagents. Reactions in aqueous solutions.
- Acid-Base Titrations
- Chemical Equilibrium. Equilibrium Constant.
- Homogeneous and Heterogeneous solution equilibria.
- Le Chatelier´s principle.
- Acid ionization constants, base ionization constants.
- Autoionization of water.
- Acid-Base Properties of Salts, pH.
- Buffer Solutions
- Solubility Equilibria.
- Galvanic Cells. Standard Reduction Potentials. The Effect of Concentration of Cell Emf.
- Corrosion. Electrolysis.
- The Rate Law. Activation Energy. Reaction Mechanisms. Factors that affect Reaction Rate.

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1. **Course number and name**
   Catalogue number: 21202
   Mechanical Physics

2. **Credits and contact hours**
   Credits: 4, Attendance hours: 5 per week, Autonomous work: 7 per week

3. **Text book, title, author, and year**
   - Halliday & Resnick, Fundamentals of physics, tenth edition, ISBN: 978-1-118-23072-5, Wiley,2014
   - Serway Raymond, Jeweet John. Physics for scientists and engineer, Cengage Learning, 9 edition (2015).
   - Sears, Semansky, University physics, 10th edition. Addison Wesley (2000).

   a. other supplemental materials
   - W. Bauer, G. D. Westfall, University physics with modern physics, 2 edition, Mc Graw Hill, (2013)

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
   The purpose of this course is to introduce to the quantitative aspects of physical mechanics application of fundamental concepts in physics and mathematics. The course includes topics like vectors, Newtonian particle mechanics, energy, momentum, several conservation laws and the application of these contexts in the experimental laboratory.
   b. Prerequisites or co-requisites. 80116 - Differential calculus
   c. Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction, ex.

   Students will be able to:
   - Interpret the results of measurements and experimental observations of two variables to approximate parameters, make predictions and compare with theoretical expectations.
   - Understand the meaning of the position, the velocity and the acceleration in translational and rotational motion and to establish relations between them for motions with uniform and non-uniform acceleration.
   - Identify any case of translational or rotational motion as the superposition of various one-dimensional movements and to establish relationships between the components of the different kinematic variables.
   - Determine the equations of translational and rotational motion for an object based on force diagrams, constant in time or not, and the initial conditions.
   - Solve problems involving translational and rotational motion.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   - (a) an ability to apply knowledge of mathematics, science, and engineering
   - (b) an ability to design and conduct experiments, as well as to analyze and interpret data.

6. Brief list of topics to be covered

1. Physical measures
   - Changing units, Orders of magnitude and scales.
2. Movement along a straight line
   - Positioning, displacement and average velocity.
   - Instantaneous velocity and speed, Acceleration.
   - Free-fall.
3. Motion in two and three dimensions
   - Vectors
   - Projectile motion, Circular motion.
   - Relative movement in two and three dimensions.
4. Laws of Newton and its Applications.
   - Friction, Drag force and terminal speed.
5. Work and kinetic energy
   - Working examples: gravitational force, electric force, variable force.
   - Power.
6. Potential energy and conservation of energy
   - Potential energy, Conservation of mechanical energy.
   - Interpretation of potential energy curves.
   - Work done on a system by an external force.
   - Conservation of energy.
7. Momentum, and Collisions
   - Conservation of momentum, Collisions and impulse.
   - The center of mass.
8. Rotating rigid bodies I
   - Angular velocity and acceleration.
   - Rotation with uniform angular acceleration.
   - Relationship between linear and rotational variables.
   - Energy in the rotational movement.
   - Moment of inertia and theorem of the parallel axes.
   - Torque
   - Newton's second law for rotational motion.
   - Rotational kinetic, work and energy.
9. Rotation of rigid bodies II
   - Rolling and Angular momentum

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3rd Semester

1. **Course number and name**
   Catalogue number: 578002
   Core Curriculum Person and Culture II.

2. **Credits and contact hours**
   Credits: 2, Attendance hours: 2 per week, Autonomous work: 2 per week

3. **Text book, title, author, and year**
   - Bauman, Z. (2005) Amor líquido: acerca de la fragilidad de los vínculos humanos. España: Fondo de Cultura Económica. ISBN 13: 9788437505886
   - Conen, C. (2012) Amor sólido: una mirada al pensamiento de Kaol Wojtyla. 4ªED. Buenos Aire: Editorial Dunken. ISBN: 9789870259886
   - Biblioteca: Sí.
   - Twain, M. (2009) El diario de Adán y Eva. 2ªED. Madrid: Valdemar. ISBN: 978-84-7702-630-3.
   - Contreras, J (2009) El sexo en pareja: ¿une o desune? Madrid: Ediciones Internacionales Universitarias. ISBN: 9788484692751

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
   The purpose of this course is that the student value the process of dating and find wealth in marriage as a vocational path.
   That the student understands that the exercise of sexuality brings consequences generated by the decisions that are made in the experience of the affective relationships so that he can be held responsible for his actions.
   b. Prerequisites 578001 *Core Curriculum Person and Culture I.*
   c. Required.

5. **Specific goals for the course**

   a. Upon completion of this course, students will be able to:
      - Respond clearly to key questions: who am I? How am I as male or female? to understand complementarity in sexual diversity.
      - To know and value the anthropological keys to live a sustainable love.
      - Understand the importance of living the natural stages of maturing love to build strong relationships.
      - Identify, understand and value elements to live harmonious and sustainable relationships
      - Understand that the exercise of sexuality brings consequences generated by the decisions that are made in the experience of the affective relationships so that he can be held responsible for his actions.
      - Identify freedom as a capacity for self-determination to act and the limits of human freedom.

- Discover happiness as the universal aspiration of human beings and their relationship to love and fullness of life possible.
- Recognize the need to cultivate an appropriate emotional climate in family relationships.
- Identify the characteristics of human care practiced in the home.

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

- (f) An understanding of professional and ethical responsibility.

6. **Brief list of topics to be covered**
   - Engagement and marriage
   - Affectivity and Sexuality

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1. **Course number and name:**
   Catalogue number 62134

   English Level 4

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - Atwell, N. (2002). Lessons that change writers. United States: Heinemann.
   - Barker, H, Cunningham, S & Moor, P. (2008). New Cutting Edge Pre-intermediate. (5th ed.). China: Pearson Education Limited.
   - Clare, A & Wilson, J. (2013). Speakout Pre-intermediate. (7th ed.). Slovakia: Pearson Education Limited.
   - Pearson-intlcom. (2016). Pearson-intlcom. Retrieved 18 October, 2016, from https://myenglishlab.pearson-intl.com/
   - Davis, R. (1998 - 2015). Esl-labcom. Retrieved August, 2015, from http://www.esl-lab.com/
   - McGraw-Hill, (Ed). (2010). Writer's Choice. (1st ed.). Columbus: McGraw-Hill.
   - Soars, J & Soars, L. (2004). New Headway Pre-intermediate. (4th ed.). England: Oxford University Press.
   - Universidad de la sabana. (2016). Virtual Sabana. Retrieved 18 October, 2016, from http://virtual.unisabana.edu.co/
   - Universidad de la sabana. (2016). Unisabana Live. Retrieved 18 October, 2016, from http://live.unisabana.edu.co/Login2.aspx?SourceURL=/

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)
      Students will be able to read and analyze written texts related to social issues such as life changes, money, technology, society, nature and fame. Similarly, they will listen to and use critical thinking to predict and draw conclusion of recordings and talks about life changes, money, technology, society, nature and fame. Students will produce 3 written compositions in which they will narrate, expound, compare and provide their opinion about social topics and their application in their own lives. Students will orally describe and give opinions about environmental problems, crime and the use of technology. Students will use information, communication, technologies (ICT) and learning strategies to become responsible for their own learning.
   b. Prerequisites: 62133 *English Level 3*
   c. Required

5. **Specific goals for the course**
   - Reading. Analyze and compare informative texts or reports about life changes money, nature, technology and crime. Find and interpret general information about environment, technology and fame. Identify specific information from texts about

life changes, money, technology and nature. Guess the meaning of unknown words from the context. Associate prior to new knowledge in factual texts. Determine the author's purpose of informative texts. Skim and scan texts to check detailed information.

- Listening. Identify the main idea of a conversation. Describe general and specific information related to life changes money, nature, technology. fame and crime. Complete texts with specific information (nouns, adjectives, verbs and figures). Understand and extract essential information from short passages that deal with every topics. Predict or anticipate ideas from a spoken text based on prior information. Identify speakers' points of view and ideas. Render the message using own words. Take notes about specific information related to technology, fame, crime, and nature.
- Speaking. Express ideas and opinions about life changes, money, nature, technology and fame using the vocabulary and grammar studied. Keep up a conversation about life changes, money, nature, technology and fame. Use appropriate pronunciation and intonation. Ask and answer questions related to their lives. Have short conversations about topics of interests. Debate about the importance/impact of technology in today's society. Record a video about crime. Design, describe and explain money making ideas. Present and defend a point of view.
- Writing. Use an appropriate rhetorical structure for 3 texts about life changes, environmental issues and cities. Use connectors, linking and transition words to write a cohesive text. Use grammar structures learnt to express ideas and opinions. Spell and punctuate accurately. Draft ideas before writing. Follow a model to write a paragraph using an appropriate structure. Write a 100 to 120 word narrative paragraph about a life changing experience. Write a 100 to 120 word expository paragraph about an environmental issue. Write a two-paragraph comparing and contrast composition about cities.

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

- g.An ability to communicate effectively

6. Brief list of topics to be covered

- Topics: changes, money, nature
- Grammar: used to – purpose, cause and result (to, so, because, in order to) - relative clauses – too much/many enough and very – comparatives and superlatives – articles.
- Vocabulary: collocations (phrasal verbs) - used to - money - nature.
- Topic: society, technology, fame
- Grammar: present and past passive, present perfect, first and second conditional.
- Vocabulary: describing a city, crime and punishment, feelings, internet terms, films and fame.

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Course Syllabi
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1. **Course number and name**
   Catalogue number 21301
   Multivariable Calculus

2. **Credits and contact hours**
   Credits: 3, Attendance hours: 4 per week, Autonomous work: 5 per week

3. **Text book, title, author, and year**
   - Stewart James, Calculus of several Variables, EarlyTrascendentals. Seventh Edition.
   - Thomas B. George, Pearson, Calculus of several Variables, Twelfth edition, México 2010.
   - Larson Ron, Hostetler P. Robert, Bruce H. Edwards, Calculus II of Several Variables. Eigth Edition, Mac Graw Hill, México 2006.

   Other supplemental materials
   - Apostol M. Tom, Calculus II. Calculus with multi-variable functions and Linear Algebra, With applications for differential equations and probability
   - Demidóvichic B. P, 5000 problems of mathematical analysis, Ninth Edition, Thomson, España, 2003.

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
      The purpose of this course is to give students the knowledge of multivariable calculus, the extension of calculus to more than one variable, in the context of vector fields. The course includes many important applications in physical quantities.
   b. Prerequisite: both. 80114 *Integral Calculus* and 80101 *Linear Algebra*
   c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction, ex.
   Students will be able to:
   - The student computes partial derivatives in order to obtain information about functions in several variables taking to account level curves, directional derivatives, implicit derivatives and the gradient vector field.
   - The student computes the flux of a vector field in R^3 along a surface via surfaces integrals or Stokes theorem or Gauss's theorem.
   - The student computes the work of a vector field in R^2 or in R^3 via line integrals, the fundamental theorem of calculus or Green's theorem.
   - The student calculates the volume of a solid in R^3 via double or triple integrals.
   - The student solve multivariable optimization problems with and without equality constraints.
   - The student calculates the mass and the center of mass of a region in R^2 or of a solid in R^3 via double or triple integrals.

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

6. Brief list of topics to be covered

1. Introduction to the Course.
   - Product point R3 and its properties.
   - Cross Product in R3 and its properties
   - Equation of lines and planes in R3
   - Cylinders and quadratic surfaces in R3.
2. Partial Derivatives
   - Functions of several variables
   - Partial derivatives
   - Tangent planes
   - Chain rule and implicit derivation
   - Directional derivatives and vector gradient
   - Minimum and minimum values
   - Lagrange multipliers.
3. Multiple integrals
   - Double integrals on rectangles
   - Iterated Integrals
   - Double integrals on general regions
   - Polar coordinates
   - Double integrals in polar coordinates
   - Triple Integrals
   - Triple Integrals in Cylindrical Coordinates
   - Triple integrals in spherical coordinates
   - Applications of multiple integrals
   - Change of variables in multiple integrals
4. Vector Analysis
   - Vector functions and curves in R3
   - Vector fields
   - Line integral
   - The fundamental theorem for line integrals
   - Green's Theorem
   - Rotational and divergence
   - Parametric surfaces and their tasks
   - Surface Integrals
   - Stokes's Theorem
   - The Divergence Theorem

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1. **Course number and name:**
   Catalogue Course Number: 21205
   Organic Chemistry

2. **Credits and contact hours:**
   Credits: 4, Contact hours: 7, Individual work hours: 5

3. **Text book, title, author, and year**
   - Organic chemistry. International Edition. McMurry, J. (2011). Monterey, Calif: Cengage Learning. ISBN 084005453X, 9780840054531.

   Other supplemental materials
   - Organic Chemistry, Leroy G. Wade, Whitman College. (2013). 8th Edition. Pearson. ISBN-13 9780321768414.
   - Organic Chemistry, Robert T. Morrison, Robert N. Boyd. (1992). 6th Edition. Prentice Hall. Englewood Cliffs. ISBN-13: 978-0136436690.
   - March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. Michael B. Smith, Jerry March. (2007). Sixth Edition. John Wiley & Sons, Inc. ISBN: 9780471720911.
   - Organic Chemistry. Jonathan Clayden, Nick Geeves, Stuart Warren. (2012). 2nd Edition. Oxford University Press. ISBN: 978-0199270293.
   - The Systematic Identification of Organic Compounds, 8th Edition. Ralph L. Shriner, Christine K. F. Hermann, Terence C. Morrill, David Y. Curtin, Reynold C. Fuson. (2004). John Wiley & Sons, Inc. ISBN: 978-0-471-21503-5.

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**
      The intent of this course is for students to understand the basic principles of carbon chemistry, recognizing the basic functional groups, each of which will be interpreted based on their physical properties, reactivity, synthesis and their natural sources. Also, the students will recognize each of the functional groups on the basis of their nomenclature. In addition, some biological and industrial applications of certain compounds containing this functional group will be explored further and specific. Finally, it will be analyzed how the presence of certain functional groups can affect the environment and life. As this subject is theoretical and practical, the student must prepare and plan the practice from the theoretical knowledge previously acquired, and then, using experimental techniques already known characterize an organic compound, perform the synthetize of complex molecules, separate and purify them and finally characterize them using spectroscopic technique that will learn in the course.
   b. **Prerequisites** 21204 – *General Chemistry II*
   c. Required

5. **Specific goals for the course**

a. Specific outcomes of instruction:
The student will be able to:

- Identify and differentiate organic compounds through their functional groups.
- Name and formulate organic compounds correctly.
- Recognize the different types of hybridization of carbon, oxygen, nitrogen and sulfur atoms.
- Differentiate and establish the fundamental characteristics of organic isomers.
- Describe the relationship between structure and reactivity of organic compounds.
- Interpret and explain the reactivity of organic compounds according to the types of reactions.

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

- b – The student learns how to perform experiments and obtain data.
- c – The student understand design concepts.
- h – Applies sustainability concepts.
  k – Ability to use modern tools.

6. Brief list of topics to be covered

Hydrocarbons and reactivity:

- Representative carbon compounds and their nomenclature (functional groups).
- Hydrocarbons: Alkanes, Alkenes, Alkynes, cycles. Isomers.
- Reactions of alkanes: Oxidation, combustion and halogenation (free radicals).
- Reactions of alkenes and alkynes: electrophilic addition, oxidation.
- Stereoisomerism: Origin of cis-trans isomers. Chirality and enantiomers, chiral carbons, R and S configuration.

Organic chemistry reactions:

- Aromatic Compounds: Structure and resonance. Reactions of aromatic compounds: electrophilic substitution.
- Halogenated compounds: physical properties.
- Nucleophilic substitution: SN1 and SN2 reactions. Elimination Reactions E1 and E2.
- Alcohols, phenols and thiols: classification. Reactions. Sources and industrial applications.
- Ethers and Epoxides: Structure, physical properties and reactions. Applications and industrial sources.
- Aldehydes and ketones: Physical properties, chemical reactions.
- Carboxylic acids and their derivatives: Characterization, physical properties, synthesis, chemical reactions, sources and specific applications.
- Amines and Heterocyclic Compounds: Classification and Structure, basicity and reactions.

Laboratory skills:

- Qualitative elemental analysis of organic compounds.
- Identification of functional groups by simple reactions.
- Use of the different distillation techniques.
- Synthesis of complex molecules and identification by spectroscopic

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1. **Course number and name**
   Catalogue number: 21302
   Physics, electricity and magnetism

2. **Credits and contact hours**
   Credits: 4 - Attendance hours: 5 per week - Autonomous work: 7 per week

3. **Text book, title, author, and year**
   - Halliday & Resnick, Fundamentals of physics, tenth edition, ISBN: 978-1-118-23072-5, Wiley, 2014.
   - Sears, Semanski , University Physics, Volume 1 , Pearson, 12 Edition.
   - Giancoli, Physics for Scientists and Engineers with Modern Physics, Fourth Edition, 2014.

   Other supplemental materials
   - Serway Raymond ,Jeweet John . Physics for science and engineering, volume 2, cengage Learning, Ninth Edition.

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
      The purpose of this course is to introduce to the quantitative aspects of physical mechanics application of fundamental concepts in physics and mathematics. The course includes topics like electric fields, Gauss' law, electrical potential, current, resistance and the application of these contexts in the experimental laboratory
   b. prerequisites or co-requisites. 21202 *physical mechanics*.
   c. Required

5. **Specific goals for the course**
   a. Students will be able to:
      - Apply the properties of electric charge to compute a particle state of movement by using the electric field from several charge distributions, the electric flux or by means of energy conservation.
      - Apply Kirchhoff rules and Ohm law to compute currents, voltages and power on any direct-current circuit element with resistances and capacitors.
      - Determine the magnetic force and torque on charged particles, wires with current, current loops and other configurations.
      - Compute the induced fem due to changes in magnetic flux on several configurations including the computation of inductance, applying this also to the study of RLC circuits.
      - Apply Maxwell equations and identifies the different regions of the electromagnetic spectrum.
   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      - (a) an ability to apply knowledge of mathematics, science, and engineering
      - (b) an ability to design and conduct experiments, as well as to analyze and interpret data.

6. **Brief list of topics to be covered**
   1. **Introduction to the course**
      - Properties of the electric charge: quantization, conservation, Conductors and insulators.
   2. **Coulomb Law and Electric Field**
      - Coulomb law. Principle of overlap.
      - Definition of electric field. Electrical field of point loads and continuous distributions and Electric field lines, Electrical dipole.
   3. **Gauss's Law**
      - Electric flow, Gaussian law.
      - Applications of the Gaussian law to various geometries and Properties of conductors.
   4. **Electric potential**
      - Electrical potential energy, Electrical potential due to point loads and continuous distributions.
      - Equipotential surfaces and Relationship to electric field: Potential gradient.
   5. **Capacitance and dielectrics**
      - Definition and calculating of capacitance.
      - Combinations and circuits with capacitors and Dielectrics and molecular models.
   6. **Definition of electric current.**
      - Resistivity and resistance, Ohm's Law and Power in circuits.
   7. **Direct Current (DC) Circuits**
      - Combination of resistors.
      - Laws of Kirchhoff, Measuring instruments and Resistance and capacitance (RC) circuits.
   8. **Magnetic field**
      - Definition of magnetic field.
      - Magnetic force on a moving load, Magnetic field and magnetic flux lines, Magnetic force on a current, Magnetic torques on current loops and The dipole magnetic moment.
   9. **Magnetic field due to currents.**
      - Magnetic field due to a moving load, Magnetic field due to a current, Magnetic force between two parallel conductors and Ampere Law.
   10. **Induction and Inductance**
      - Faraday's Law and Lenz's Law, Induction and energy, Induced electric fields, Inductors and Inductance, Self-induction.
      - Mutual inductance and RL, RLC circuits.
   11. **Electromagnetic waves**
      - Displacement current,
      - Integral and differential form of the Maxwell equations.
      - Electromagnetic waves and Electromagnetic spectrum.

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1. **Course number and name:**
   Catalogue number: 21404

   Thermodynamics

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**

- ÇENGEL, Y. A. and BOLES, M. A. 2009. Thermodynamics: an engineering approach, 7th Ed., McGraw-Hill Higher Education, Boston.

a. **Other supplemental materials**

- WARK, K. and RICHARDS, D. E. 1999. Thermodynamics, 6th ed. Ed., WCB/McGraw-Hill, Boston ; London.
- SMITH, J. M., VAN NESS, H. C. and ABBOTT, M. M. 2005. Introduction to chemical engineering thermodynamics, 7th Ed., McGraw-Hill, Boston.
- SONNTAG, R. E., BORGNAKKE, C. and VAN WYLEN, G. J. 2003. Fundamentals of thermodynamics, 6th ed. / Richard E. Sonntag, Claus Borgnakke, Gordon J. Van Wylen. Ed., Wiley, New York, N.Y. ; [Chichester].
- POLING, B. E., PRAUSNITZ, J. M. and O'CONNELL, J. P. 2007. The properties of gases and liquids, 5th ed. International ed. / Bruce E. Poling, John M. Prausnitz, John P. O'Connell. Ed., McGraw-Hill, Boston, [Mass.]

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**
      Determine the properties of real substances and ideal gases from tabulated data, graphs or equations of state. Analyze processes involving ideal gases and real substances as working fluids in both closed and open systems (control volumes) to determine process diagrams, apply the first law of thermodynamics to perform energy balances, and determine the heat transfer and work. Analyze systems and control volumes through the application of the second law of thermodynamics

   b. **Prerequisites or co-requisites**
      80116 - Differential Calculus

   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
      Required

5. **Specific goals for the course**
   a. **Specific outcomes of instruction**,
      It is expected that at the end of the course the student Apply principles of math, science, and engineering in problem solving Identify, formulate and solve

engineering problems associated with open and closed systems using both ideal gases and actual substances as working fluids. Demonstrate the effective use of the Internet to explore topics of thermodynamics related to energy generation, its transformation and the implications on society and the environment.

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

- A. An ability to apply knowledge of mathematics, science, and engineering
- E. An ability to identify, formulate, and solve engineering problems

6. Brief list of topics to be covered

- Energy, thermodynamic system. Postulate of state. Process, trajectory and cycle. Properties: mass, volume, pressure and temperature. Thermal equilibrium: zero law of thermodynamics. Dimensions and units.
- Balance of energy - first law transfer of energy and types of energy
- Heat transfer. Border work and other forms of work. Internal energy. Enthalpy
- Prediction of properties. Pure substances: phases of a pure substance. Phase changes, phase diagrams t-v, p-v. Internal energy and enthalpy. Thermodynamic properties tables. Determination of properties. Ideal gas: equation of state. Relations of internal energy, enthalpy and heat capacities. Other state equations: compressibility factor and principle of the corresponding states. Incompressible substances: heat capacities of liquids and solids.
- First law in closed systems. Mass conservation and energy balance: general energy equation
- First law in control volumes. The process of permanent flow. Mass flow. Mass conservation and energy balance: general energy equation. Application to process equipment such as: boilers, turbines, compressors, heat exchangers, nozzles, diffusers, valves, evaporators, condensers
- Second law of thermodynamics. Thermal machines, refrigerator and heat pump: thermal efficiency and cop. Pronouns of Kelvin-planck and clausius. Reversible and irreversible processes. Carnot cycle. Ideal machine, maximum efficiency, maximum work. The thermodynamic temperature scale. Inverted carnot cycle. Refrigerator and heat pump. Cop maximum and minimum work.
- Concept of entropy. Degradation of energy. Principle of entropy increase. Entropy variation of the system and its environment. Entropy as thermodynamic property of liquids, vapors, gases and solids. Isentropic process and isothermal process. Entropy balance. Isentropic Efficiencies of Equipment and Apparatus

4th Semester

1. **Course number and name**
   Catalogue number 578003
   Core Curriculum Person and Culture III.

2. **Credits and contact hours**
   Credits: 2, Attendance hours: 2 per week, Autonomous work: 2 per week

3. **Text book, title, author, and year**
   - Lorda, J. L. (2015). Antropología teológica. 2ª ed. Pamplona: Ediciones Universidad de Navarra. ISBN: 9788431329105
   - Ivereigh, A. & Cierva, de Y. (2016). Cómo defender la fe sin levantar la voz: respuestas civilizadas y preguntas desafiantes. Madrid: Palabra. ISBN: 9788490614389
   - Izquierdo, C., Burggraf, J., & Arocena, F. M. (2014). Diccionario de teología. Pamplona: Ediciones Universidad de Navarra. ISBN: 9788431329792
   - Hahn, S. (2008). La fe es razonable: cómo comprender, explicar y defender la fe católica. Madrid: Rialp. ISBN: 9788432137051
   - Tomás de Aquino, S. (2012). Suma teológica. Parte I, Cuestión 2 "Sobre la existencia de Dios". Madrid: Biblioteca de Autores Cristianos. ISBN: 9788422014324
   - Burggraf, J. (2010). Teología fundamental: manual de iniciación. Madrid: Rialp. ISBN: 9788432133831

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
      The purpose of this course is show the value and necessity of a life open to transcendence and personal relationship with God, to contribute to the construction of peace and to foster hope.
   b. prerequisites or co-requisites. 578002 *Core Curriculum Person and Culture II.*
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. **Specific goals for the course**
   a. Upon completion of this course, students will be able to:
      - Encourage students in primary values such as: reflection on aspects of scope constructive and respectful dialogue on them, opening to plurality, the incorporation to the own life of the principles and values in which they believe.
      - Discover and find God.
      - Formulate and responds to fundamental existential questions.
      - Has a positive approach to faith.
   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      - (f) An understanding of professional and ethical responsibility.

6. **Brief list of topics to be covered**
   - Dimensions of human nature.
   - Perception of a higher being
   - Rites and Symbology
   - Cosmological and anthropological vestiges of the existence of a higher being.
   - Concept of Religion.
   - Unity and plurality of religions.
   - Nature and object of faith.
   - Themes: origin of the universe, of life and man.
   - What they say: philosophy, theology and sciences (biology, physics, medicine, psychology, etc.)
   - Limits of each science.
   - Knowledge of the God of the Christians in their essence.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue number: 62135
   English Level 5

2. **Credits and contact hours:**
   Credits: 3 Contact hours: 4 Individual work hours: 5

3. **Text book, title, author, and year**
   - Anderson, C. (2016). Ted Talks. United States of America: Houghton Mifflin.
   - Dummett, H, Hughes, P & Stephenson, H. (2013). Life Intermediate. (1st ed.). United Kingdom: Cengage Learning.
   - Dummett, H, Hughes, P & Stephenson, H. (2013). CD ROM. [CD ROM]. United Kingdom: Cengage Learning.
   - Heinlecom. (2016). Heinlecom. Retrieved 18 October, 2016, from https://myelt.heinle.com/ilrn/authentication/signIn.do?inst=MYELT
   - Sayer, M. (2013). Life Intermediate Teacher's Book. United Kingdom: Cengage Learning.

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**
      By the end of level 5, students will show understanding of written and oral texts related to the use of color in life and its meaning, music, performance, global entertainment, unforgettable experiences, predictions, travel experiences, great holidays and healthy lifestyles. Similarly, students will produce written compositions in which they will identify the causes or effects of globalization and how it has affected different aspects of local and worldwide culture. Students will describe unforgettable experiences, talk about predictions, exchange information about travel experiences and holidays, discuss and share their opinions on healthy lifestyles. Students will use Information, Communication Technologies (ICT) and learning strategies to become responsible for their own learning.

   b. **Prerequisites or co-requisites:** 62134 *English Level 4*

   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

5. **Specific goals for the course**
   a. **Specific outcomes of instruction**,
      Speaking: The students can agree and disagree with situations related to how globalization has affected culture sharing causes and effects. They also talk about the impact of tourism in natural settings. Learners will identify the importance of education and its impact in different places of the world.
      Writing: The students can write a four-paragraph cause and effect composition following the rhetorical structure expected for this type of texts.

Listening: The students can identify the general and specific details in the spoken discourse identifying information from academic recordings. Learners can listen to a text and fill in the gaps, answer True/False sentences and justify their answers.
Reading: The student can read and follow written discourse taken from media sources such as newspapers and magazines identifying main and specific ideas from academic texts. Also, they can recognize the general line of argument in a text but not necessarily in detail.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
g. An ability to communicate effectively

6. Brief list of topics to be covered

- Topics: Colour, performance, water.
- Vocabulary related to: Color-personality, Color-culture. Globalization, Musical styles – adjectives to describe musical styles. Tourism and its impact in the environment.
- Grammar structrues: Present simple – Present continuous - question forms – Present perfect (just, yet, already) – past perfect simple.
- Topics: Opportunities, travel, wellbeing.
- Vocabulary related to: Education terms, Holiday destinations, Travel problems, Healthy habits.
- Grammar structures: Past Perfect Simple – Present perfect simple Vs simple past- Future forms-– First Conditional.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue number 80105
   Differential equations

2. **Credits and contact hours**
   Credits: 3, Attendance hours: 4 per week, Autonomous work: 5 per week

3. **Text book, title, author, and year**
   - Zill, Dennis and Cullen, Michael. Ecuaciones differential equations with problems with border values, Eighth Edition; Cengage Learning. México D.F.2014.
   - Boyce, William and the Prima, Richard .Elemental Differential Equation and Boundary Value Problems. Ninth Edition. John Wiley and Sons, Inc. United States of America, 2009.
   - R.k .Nagle and E.B. Saff Fundamentals of differential equations , Addison – Wesley , Iberoamericana, 1992 .

   a. other supplemental materials
   - Kiseliov, M. Krasnov and Makarenko, Problems of Ordinary Differential Equations, Mir Moscú, 1968.

4. Specific course information
   a. brief description of the content of the course (catalog description).
      The purpose of this course is to give students the knowledge for model laws of nature in terms of differential equations, solve those equations and interpret the solutions. The course includes many applications in science and engineering.
   b. Prerequisites or co-requisites. 21301 *Multivariable calculus.*
   c. Required

5. Specific goals for the course
   a. Specific outcomes of instruction, ex.
      This course requires previous knowledge on calculus in single and several variables and linear algebra. Upon completion of this course, students will be able to:
      - Solve ordinary differential equations using different methods of solutions, such as: separable variables, integrating factor, Cauchy-Euler equation, variation of parameters and Laplace transform.
      - Model basic physical systems employing differential equations.
      - Identify the solutions of a linear differential equation of higher order like a combination linear of a fundamental set of solutions
      - Solve systems of first order differential equations in applied problems.

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

6. Brief list of topics to be covered
   1. **General notions definition, order, degree, general solution and particular** solution of a differential equation
      - Initial Value Problems
   2. **First order differential equations**
      - Differential equations of separable variables
      - Homogeneous differential equations
      - Exact differential equation
      - First order linear differential equation
      - Bernoulli differential equation
   3. **Differential equations of higher order**
      - General notions
      - Linear and determinant independence of wronskian
      - Fundamental set of solutions
      - Characteristic equation
      - Differential equation of Cauchy-Euler
      - Reduction of order
      - Variation of parameters
      - Applications
   4. **Laplace transform**
      - Definitions and Properties
      - The convolution theorem
      - Initial value problem solving
      - Solution of simultaneous differential equations
      - Solution of convolutive integral-differential equations
   5. **Systems of first order linear differential equations**
      - Basic notions
      - Homogeneous linear systems
      - Non-homogeneous linear systems

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Number: 150401
   Biochemistry

2. **Credits and contact hours:**
   Credits: 4, Contact hours: 4, Laboratory hours: 3, Individual work hours: 5

3. **Text book, title, author, and year**
   Lehninger: principios de Bioquímica. Nelson, David L.; Cox, Michael M. 2014.

a. Other supplemental materials

- Bioquímica. Mathews , Christopher K.; Van Holde, Kensal E.; Appling, Dean R.; Anthony-Cahill, Spencer J. 2013.
- Bioquímica: curso básico. Tymoczko, John L.; Berg, Jeremy M.; Stryer, Lubert. 2014
- Fermentation microbiology and biotechnology. El-Mansi, Mansi; Bryce, Charlie. 1999.
- Biotechnology: an introduction. Barnum, Susan R. 2005.
- Science Direct Database.

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)
   The intent of this course is for students to learn, identify, comprehend and apply concepts regarding biochemistry such as structure and function of proteins (focusing on the importance of enzymes), carbohydrates, lipids and their role in metabolism. Considering that the metabolism must follow natural laws. This approach will be studied taking in to account those macromolecules and the metabolism as biotechnological means.

   b. **Prerequisites or co-requisites** 21205- *Organic chemistry*

   c. Required

5. **Specific goals for the course**
   a. Specific outcomes of instruction
   The student will be able to:
   - Get familiar with biochemistry terminology. Promote reading and writing outcomes related to this scientific field.
   - Develop understanding of the structures and function of some macromolecules, their importance for the organization and functioning of living beings, and the interaction with its surroundings.
   - Foster consciousness related to research as a process to create knowledge.

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

- a – ability to apply scientific knowledge.
- b – ability to design and conduct experiments
- h – ability to comprehend the impact of engineering solutions

6. Brief list of topics to be covered

- Importance of the biochemistry for the process engineering.
- Water and pH
- Water: structure and properties.
- Determination of pH for acids and bases.
- Buffers using monoprotic and polyprotic acids.
- Proteins
- Amino acids: structure and properties.
- Proteins: primary, secondary, tertiary and quaternary structures and stability.
- Purification and characterization of proteins.
- Enzymes
- Enzyme catalysis and enzyme kinetics.
- Enzymes for industrial applications.
- Carbohydrates
- Structure and function of monosaccharides, oligosaccharides and polysaccharides.
- Industrial uses of carbohydrates.
- Bioenergetics
- Energy transfer molecules in living beings.
- Free energy and coupling reactions.
- Metabolism
- Catabolism of carbohydrates. Fermentation. Glycogen and glucose anabolism. Citric acid cycle. Electron transport chain and oxidative phosphorylation. Degradation and synthesis of lipids. Photosynthesis. Metabolism of proteins and amino acids. Nitrogen metabolism and urea cycle. The integration of metabolism.
- Metabolic pathways with industrial applications.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue number 150402
   Equilibrium thermodynamics

2. **Credits and contact hours**
   Credits: 3 Attendance hours: 4 per week Autonomous work: 5 per week

3. **Text book, title, author, and year**
   - Y. A. Cengel, M. A. Boles, Thermodynamics, 5th ed. McGraw Hill. Mexico City, Mexico. 2007.
   - M.J. Moran, H.N. Shapiro, Fundamental of Engineering Thermodynamics, 5th Ed
   - S.I. Sandler, Chemical and Engineering Thermodynamics. 3rd edition 1999. John Wiley and Sons

   Other supplemental materials
   - J. M. Smith, H. C. Van Ness, M. M. Abbott, Introduction to Thermodynamics in Chemical Engineering, 5th Ed. McGraw Hill, Mexico City (Mexico). 1997.
   - Ismael Tosun. The Thermodynamics of Phase and Reaction Equilibria. 1st Edition. Elsevier, 2013

4. Specific course information
   a. Brief description of the content of the course (catalog description).
      This course complements the basic course of thermodynamics by applying previously acquired thermodynamic concepts to the equilibrium of mixtures, the phase balance in ideal and non-ideal mixtures, and the equilibrium of reactions. It begins with the study of the exergy in open and closed systems, and its extension in power generation systems as an application of chemical thermodynamics, continues to introduce the criterion of equilibrium and phase stability, including the concept of fugacity, calculations for properties of mixtures, excess properties and activity coefficients, emphasis is given to calculations related to phase equilibrium and equilibrium in chemical reactions.
   b. Prerequisites or co-requisites: 21404 *Thermodynamics*
   c. Required.

5. Specific goals for the course
   This course requires previous knowledge on basic statistics and operation management. Upon completion of this course, students will be able to function on teams to model systems with stochastic characteristics, then the students will be able to:
   - Design experiments: collect, choose and process data, using statistical tools.
   - Apply the steps of a simulation study.
   - Build models using specialized software.
   - Evaluate alternatives and interpret the statistical analysis results to take decisions.

   a. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

- Student Outcomes E and K

6. Brief list of topics to be covered

- Exergy. Definition, importance. Exergy calculations for a system in a given state. Exergy calculations for closed and open systems. Exergetic efficiency for common equipment: pumps and compressors, turbines, heat exchangers. Desertion of exergy.
- Power Cycles. Rankine cycle of steam power, irreversibilities in power cycles by steam, regeneration and exergetic analysis. Cooling power cycles. Brayton cycle of gas power. Combined cycles. Exergetic analysis.
- Criteria for balance. Gibbs Free Energy and Pure Compound Fugacity. State equations for fugacity and coefficient of fugacity of pure compounds.
- Thermodynamic description of mixtures. Gibbs Partial Molar Energy, and generalized Gibbs-Duhem equation. Variation equations for multicomponent systems. Criterion for the equilibrium in multicomponent systems. Rule of Gibbs phases. Ideal mix. Gibbs partial molar energy and fugacity. Ideal blend and excess properties. Fugacity in mixtures of gaseous, liquid, and solid species.
- Introduction to equilibrium Liquid vapor. Balance diagram Liquid - Steam at constant temperature. Diagram of equilibrium Liquid - Steam at constant pressure. Applications of liquid-vapor equilibrium in chemical engineering.
- Raoult's Law for Liquid Equilibrium Steam. Bubble Point, Dew Point. Liquid Balance - Steam Calculations. Construction of Pxy and Txy diagrams.
- Partition Coefficient, K. Flash distillation. Theoretical Stages of Distillation.
- Depriester diagrams for hydrocarbons.
- Raoult's Law Modified - Calculations in equilibrium Liquid vapor at low pressures. Introduction of the Activity Coefficient.
- Construction of Pxy Diagrams, Txy, non-ideal ELV calculations.
- Models for the determination of the Activity Coefficient from experimental data. Coefficient of activity at infinite dilution. Equations of Margules and Van Laar.
- Local Composition models for activity coefficients, NRTL, Wilson
- UNIQUAC - UNIFAC - Workshop to develop liquid-vapor equilibrium model using UNIFAC, and construction of Pxy and Txy diagrams.
- Content Block 4 (3rd Court)
- Gamma-Phi formulation of the liquid vapor equilibrium. Bubble Point and Spray Calculations Gamma-Phi Formulation of the Steam Liquid Balance.
- Liquid-Liquid Balance. Liquid-liquid-vapor balance
- Solid Balance - Liquid. Solid-steam balance.
- Balance in chemical reactions. Reaction coordinate. Stoichiometry of reactions. Application of equilibrium criteria to chemical reactions. Evaluation of equilibrium constants.
- Effect of temperature on equilibrium constant. Effect of concentration on the equilibrium of the reaction. Evaluation of the effect of pressure on the equilibrium of the reaction.
- Simultaneous reactions, homogeneous and heterogeneous reactions.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 21405
   Mass and energy balance

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - Book, Elementary Principles of Chemical Processes, Richard Mark Felder and Ronald W. Rousseau, 2004.
   - Book, Basic Principles and Calculations in Chemical Engineering, David M. Himmelblau and James B. Riggs, 2004.
   - Book, Introduction to Material and Energy Balances, Gintaras Reklaitis, 1989.

   Other supplemental materials
   - Book, Problemas de balance de materia y energía en la industria alimentaria, A. Valiente Banderas, 1998.
   - Book, Introduction to Chemical Processes: Principles, Analysis, Synthesis, Regina M. Murphy, 2006.

4. **Specific course information**
   a. **Brief description of the content of the course**
      The materials and energy balance course allows the student to apply the principles of the mass and energy conservation laws to solve engineering problems involving any transformation of raw material. The course integrates knowledge of several engineering areas, such as thermodynamics, mathematics, and chemistry, which are presented in previous courses. Likewise, topics and methodologies presented in this course will be used for the design of equipment and processes, which are themes will be exposed in later courses.
   b. No prerequisites
   c. Required

5. **Specific goals for the course**
   a. **Specific outcomes of instruction**
      - The student will integrate knowledge of mathematics, chemistry, and thermodynamics to solve problems of material and energy balances.
      - The student will be able to use advanced techniques and technological tools to solve basic problems of process engineering.
      - The student will can make engineering decisions about production processes, considering economic, social, and environmental aspects that frame the process
      - Students will improve their ability to work as a team. In addition, they will be able to work under pressure and make decisions in critical situations.

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

- a - Applies knowledge of science, mathematics and engineering
- e - Solves engineering problems.

6. **Brief list of topics to be covered**

Characterization of chemical processes:

- Process diagram
- Process variables

Material balances in chemical process:

- Material balances introduction
- Material balance in process without chemical reactions
- Material balance in process with chemical reactions
- Material balance in several units
- Elemental analysis in reactive process

Energy balances in chemical process:

- Energy balances introduction
- Energy balance in process without chemical reactions
- Psychometric
- Energy balance in process with chemical reactions

Material and energy balances in chemical process:

- Strategies for the simultaneous solution of material and energy balances

5th Semester

1. **Course number and name**
   Catalogue Course number: 578004
   Core Curriculum Person and Culture IV.

2. **Credits and contact hours**
Credits: 2 Attendance hours: 2 per week Autonomous work: 2 per week

3. **Text book, title, author, and year**
   - Hosseini, K. (2003). Cometas en el cielo. Salamandra. ISBN: 9788498380729
   - Dostoievski, H. (2015). Crimen y castigo. Penguin Clasicos. ISBN: 849105006X
   - Ayllón, J. (2010). Desfile de modelos: análisis de la conducta ética. Ediciones Rialp. ISBN: 9788432131691
   - Sonnenfeld, A. (2014). El nuevo liderazgo ético: la responsabilidad de
   - ser libres. Madrid: Fragua. ISBN: 9788470745898
   - Tolkien, J.R.R. (2006). El señor de los anillos I: La comunidad del anillo. Malaga: Minotauro. ISBN: 8445076116
   - Sandel, M. (2011). Justicia: ¿hacemos lo que debemos?. Debate. ISBN: 9788483069189
   - García Pelegrín, J. (2006). La Rosa Blanca. Libros Libres. ISBN: 9788496088467
   - Abadía, L. (2010). La crisis ninja y otros misterios de la economía actual. Espasa. ISBN: 9788467030150
   - Mutch, Barbara (2012). La hija de la criada. Alianza. ISBN: 9788420675664
   - Llano, A. (2009). La vida lograda. Ariel. ISBN: 8434412322
   - Pieper, J. (2003). Las virtudes fundamentales. Rialp. ISBN: 8432148318
   - Sonnenfeld, A. (2012). Liderazgo ético: la sabiduría de decidir bien. Ediciones encuentro. ISBN: 9788499200460
   - Lee, H. (2015). Matar a un ruiseñor. Ediciones B. ISBN: 9788468767024
   - Martínez-Sáez, S. (2008). Relativismo ético. Persona y Bioética. ISSN: 0123-3122
   - Murillo, J. (2009). Studia Poliana. Departamento de filosofía universidad de navarra. ISBN: 23871830
   - Aristóteles (2009). Ética a Nicómaco. Centro de Estudios Políticos y Constitucionales. ISBN: 9788430948154

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
   The purpose of this course is provide students with the knowledge and tools necessary for each one to seek and find the path that leads to the fullness of life, through their personal choices.
   b. prerequisites or co-requisites. 578003 *Core Curriculum Person and Culture III.*
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. **Specific goals for the course**

a. Upon completion of this course, students will be able to:
- Understands the factors that make him grow as a person and make him an administrator of his own life.
- Understand the importance of choosing well in order to be an authentic person.
- Develops the different virtues that perfect him as a person, making him good.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
- (f) An understanding of professional and ethical responsibility.

6. **Brief list of topics to be covered**
- Relationship between human behavior and ethics. The moral experience as a starting point for ethical reflection.
- Relationship between ethics, freedom and responsibility.
- Concepts of virtue and vice.
- Coherence and hypocrisy in human action.
- Voluntary action and its moral specification: Relationship between mind and brain.
- Willpower (want want) It is possible to improve.
- Freedom and moral habits: Difference between the spontaneous (the instinctive) and the natural (the rational).
- Acquisition of virtues or good habits.
- The role of the global conception of the human good in ethics
- Happiness as the ultimate goal (télos) of the person (Relationship between nature, freedom and human fulfillment).
- Have noble ideals. Relationship between happiness and hope. Contribution to the common good. Contemporary hedonism and skepticism.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue number: 62136
   English Level 6

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - Sthephenson, H; Dumment, P & Hughes, J.K (2013). Life intermediate. Canda: Cengage Learning Macgillivray, M & Yancey, P. (2008). Extensive Reading for academic success. Advanced C. Compass Publishing.
   - Cohen, R & Miller, J. NorthStar. (2003). Reading and Writing, advanced. Person Longman Press. Anderson, N. (2002). Active skills for reading: Book 3.Thomson Learning.
   - Evans, V., & Dooley, J. (2002). Upstream: Intermediate. Kraków: Wydawnictwo
   - Egis. http://www.ted.com/
   - Virtual Sabana-Moodle - National Geographic Virtual Library
     Online resources such as you.tube videos and different articles.

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**
      By the end of level 6, students will demonstrate a solid understanding of written and oral texts related to living spaces, weird news, trade and money use, the latest advances in medicine, inspirational people, communication, and the experts of different fields. Similarly, students will produce a written composition and orally persuade an audience and readers about the topics mentioned before. Also, students will talk, express preferences and give reasons about weird news, homes, and technological advantages in medicine, and describe a campaign in regards to money use. Furthermore, students will use Information and Communication Technologies (ICT) and learning strategies to become responsible for their own learning.

   b. **Prerequisites or co-requisites:** 62135 *English Level 5*
   c. **Indicate whether a required, elective, or selected elective course in the program:** Required

5. **Specific goals for the course**
   a. **Specific outcomes of instruction**,
      - Speaking. The student can provide arguments to support his opinion towards a given topic from the main objetive of the course.
      - Listening. The student can anticipate information to identify specific details in a conversation. The student can understand the main points of clear standard speech and relate the information to their experiences.

- Reading: The student can show understanding of academic texts by explaining and expanding on the topics explored in the suggested texts. The students can discuss, agree and/or disagree with the topics presented in the suggested texts. Furthermore, the student can answer different type of questions (Matching headings to paragraphs, vocabulary in context, passage idea, author's purpose, factual and inferencial questions).
- Writing. The student can write accurate and complete topic sentences and paragraphs in a persuasive essay. The student can use connectors and linking words. Moreover, there is a wide use of appropriate simple and complex grammar structures.

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

- g. An ability to communicate effectively

6. Brief list of topics to be covered

- Topics: Living Space / Weird News / Trade
- Vocabulary related to: Features of homes in the city, the natural world weird characteristics, money /shopping.
- Grammar Structures: Comparatives and Superlatives, Used to, Modal verbs (Speculation in present and past), Passive voice.
- Topics: No limits! /Connections / Experts
- Vocabulary related to: Medicine, Communications and Technology, Field Trips.
- Grammar Structures: Defining Relative Clauses, second conditional, Reported Speech and Reporting Verbs, Third Conditional.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 150501
   Chemical Instrumental Analysis

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 7, Individual work hours: 5

3. **Text book, title, author, and year**
   - Modern Analytical Chemistry, David Harvey, 2000

   a. Other supplemental materials
   - Quantitative Chemical Analysis, Daniel Harris, 2010
   - Fundamentos de Química Analítica, Douglas Skoog, Donald West, James Holler, Stanley Crouch, 2015
   - Principios de Análisis Instrumental, Douglas Skoog, James Holler, Stanley Crouch, 2008
   - Spectrometric identification of organic compounds, Robert Silverstein, Francis Webster, David Kiemle, 2005

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)
   In the laboral field of the engineering in different occasions to showing up unanswered questions as: ¿What is it? and/or ¿How much is it? The answers of these unanswered questions could give the analytical chemistry, which to have two branch: Qualitative Chemical Analysis and Quantitative Chemical Analysis. In this course will be included both, focusing mainly on instrumental techniques that allow to solve the unanswered questions considering, from the mathematical resolution using stoichiometry and the understanding of the chemical phenomenon.

   b. Prerequisites or co-requisites
   - 150401 *Biochemistry*

   c. Required

5. **Specific goals for the course**

   a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
   The student will be able to:
   - Relate the Instrumental Analysis Chemistry to the needs of Chemical Engineer.
   - Carry out guidelines for the student can describe simple and complex chemical systems.
   - Confirm experimentally the behavior of different chemical systems and understanding which factors to concern its.
   - Understand the basis of the instrumental methodologies.

- Make use of the knowledge achieve related to the instrumental techniques in the resolution of problems regarding the composition and identification of study samples.
- Develop the ability of select the methodology and the instrument indicated for the resolution of one particular problem.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. (según Tabla ABET)

- a - Applies knowledge of science, mathematics and engineering
- B - Makes experiments and interpret the result obtained.

6. Brief list of topics to be covered

Introduction:

- Significant Figures
- Units of concentration
- Statistics and Measurement

Classical Chemical Analysis:

- Volumetric Analysis
- Gravimetric Analysis

Instrumental methods:

- Calibration methods for quantification
- Ultraviolet-visible spectroscopy
- Infrared Spectroscopy
- Emission and Absorption Spectroscopy
- Mass spectrometry
- Liquid and Gas Chromatography

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 21502
   Transport Phenomena

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - Fenómenos de transporte. Byron Bird, Robert, Stewart, Warren E.; Lightfoot, Edwin N.; Villagómez Velázquez, Hugo; Zetina Vélez, Alma Rosa Griselda. 2009

a. Other supplemental materials
- Transferencia de calor y masa un enfoque práctico. Cengel, Yunus Ali. 2011
- Mecánica de fluidos: fundamentos y aplicaciones. Cengel, Yunus Ali, Cimbala, John M.; Faddeeva Sknarina, Sofía; Peña Brandés, Alberto; Campos Olguín, Víctor; Sarmiento Ortega, Sergio; Sánchez Fragoso, Francisco. 2011
- Heat transfer: a practical approach. Cengel, Yunus Ali. Serie:McGraw-Hill series in mechanical engineering 2003
- Fluid Mechanics. White, Frank M. 2011

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)
   The intent of this course is for students to learn, identify, comprehend and apply concepts and mathematical expressions regarding transport phenomena related to movement, energy and mass. This phenomenon will be studied from both a micro and macroscopic point of view, applied to an element of volume, using equations of movement, heat and mass, with emphasis in the mathematical resolution of such equations, and discussions of the significance of results. Application of such equations to complex systems and macroscopic systems, searching for the assimilation of these concepts and the application of such knowledge to the analysis of real processes.

   b. Prerequisites or co-requisites
   Prerequisites: 80105 - *Differential Equations*

   c. Indicate whether a required, elective, or selected elective course in the program
   Required

5. **Specific goals for the course**
   a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
   The student will be able to:

- Understand the basic principles that govern the transfer laws of movement, energy and mass transport.
- Resolve one dimensional mathematical models for singular transport phenomena systems and calculate values for variables of interest.
- Apply mathematical models to the analysis and resolution of problems involving transport phenomena.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. (según Tabla ABET)

- e - Solves engineering problems.
- a - Applies knowledge of science, mathematics and engineering
- C- ability to design a system or component

6. Brief list of topics to be covered

Momentum:

- Viscosity and Newton´s Law of Viscosity.
- Molecular mechanism of movement transport phenomena
- Isothermal and Unidimensional Flow. Flat plate, cylindrical flow, Tangential flow.
- Multidimensional flow systems.
- Dimensional Analysis. Scaling
- Velocity Distribution in Turbulent flow
- Friction Factors. Reynolds Number. Bernoulli Equation, Macroscopic analysis in a pipe system

Energy:

- Fourier Law of Conductivity and energy transport mechanisms. Conduction, convection and radiation.
- Equations for energy variation in non-isothermal systems
- Conduction in stationary state
- Convection heat transport
- Heat transfer in macroscopic balances, applied to heat exchangers, global heat coefficient, fouling factor

Mass:

- Fick´s Law of Diffusion and Mass transport mechanisms
- Molecular diffusion in stationary state
- Unidirectional Mass transfer by convection
- Variation equations for mass transfer
- Macroscopic balances for mass transfer in stirred tanks.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue number: 150503
   Materials and Nanomaterials Science

2. **Credits and contact hours**
   Credits: 3, Attendance hours: 4 per week, Autonomous work: 5 per week

3. **Text book, title, author, and year**

4. **Specific course information**
   a. Brief description of the content of the course (catalog description).
      The course has the objective to build the basis of the study of materials for engineering applications. The first part of the class will explore the relationship between the electronic structure and chemical bonding and atomic order. The second part considers the properties of materials such as: Metals, polymers, ceramics and semiconductors. The third part considers the behavior of materials when the nanometer scale is reduced.

   b. Prerequisites or co-requisites. 21302 *Physics, electricity and magnetism.*

   c. Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
      This course requires previous knowledge on basic statistics and operation management. Upon completion of this course, students will be able to function on teams to model systems with stochastic characteristics, then the students will be able to:
      - Design experiments: collect, choose and process data, using statistical tools.
      - Apply the steps of a simulation study.
      - Build models using specialized software.
      - Evaluate alternatives and interpret the statistical analysis results to take decisions.

   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      - Student Outcomes A and E

6. **Brief list of topics to be covered**
   - Materials Science Definition
   - Integral Definition of a property

- Matter : Levels of Structure
- Bonding and Molecules
- Primary Bonding
- Secondary Bonding
- Electrical Properties
- Band Theory : Metals , Insulators , Semi- Conductors, Energy gap , doping ,applications.
- Crystaline Materials:
- Crystaline Structures, Bravaii
- Lattices , miller index
- x-ray diffraction
- Defects : Point , line, surface
- Introduction to glasses
- Arrhenius Equation
- Diffusion : Ficks Laws
- Mechanical Properties of Materials.
- Deformation : Elastic and Plastic
- Solidification
- Solid Solutions:
- Phase diagrams , partial Solubility and full solubility
- Organic Materials
- Polymers
- Synthesis, properties and applications.
- Composite Materials
- Introductions to nanotechnology
- Quantum Systems
- Applications for nanotechnology

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number:150504
   Optimization in Chemical Engineering

2. **Credits and contact hours:**
   Credits: 2, Contact hours: 4, Individual work hours: 2

3. **Text book, title, author, and year**
   Edgar T. F. Himmelblau D. M. Optimization of Chemical Processes McGraw Hill 2001

a. **Other supplemental materials**
   • Biegler L. T. Grossmann I. E. Systematic method for chemical process design Prentice Hall 1997
   • Bhatti M. A. Practical Optimization Methods: With Matematical Application Springer Telos. 1998
   • Hooker, J N Integrated Methods for Optimization. New York Springer.
   • Sun W. Yuan Y. X. Optimization Theory and Methods Springer Disponible en Linea 2006
   • Yang Y. S. Computational Optimization, Methods and Algorithms Springer Disponible en Linea. 2011 enkataraman. P Applied Optimization with MATLAB Programming, 2nd Edition. Wiley. 2009
   • Venkataraman. P Applied Optimization with MATLAB Programming, 2nd Edition. Wiley. 2009
   • Taha, H. Operation Research 9th edition. Pearson.
   • Chapra S., Canale R. Métodos Numéricos para ingenieros MCGraw-Hill. 1999.

4. **Specific course information**

a. **Brief description of the content of the course (catalog description)**
   The subject includes the study of optimization and its application in engineering. Numerical techniques developed throughout the course will allow define and solve mathematical problems associated with optimization in chemical processes, with the economic analysis of manufacturing processes.

b. **Prerequisites or co-requisites**
   Prerequisites: - 80105 *Differential Equations*

c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
   Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**, ex. The student will be able to explain the significance of current research about a particular topic.
   The student will be able to:

- Understand the basic principles in optimization
- Apply numerical methods to the analysis and resolution of problems in chemical process
- Resolve models associated with optimization in chemical engineering.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. (según Tabla ABET)

- a - Applies knowledge of science, mathematics and engineering
- k - Uses modern techniques, skills and tools for the practice of engineering.

6. Brief list of topics to be covered

- Basic concepts of optimization
- Linear programming
- Nonlinear programming
- Mixed-Integer optimization
- Numerical methods
- Application in chemical reactors

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue course number 122304
   Probability and statistics I

2. **Credits and contact hours**
   Credits: 2, Attendance hours: 4 per week, Autonomous work: 2 per week

3. **Text book, title, author, and year**
   - WALPOLE, Ronal E and Myers , Raymond H and Myers , Sharon L, Keying ye, Probability and statistics for engineers -Ninth Edition , Pearson Education, 2012.
   - ANDERSON, David R , Sweeney , Dennis J , Williams , Thomas A, Statistics for administration and economy - Tenth Edition , Cengage Learning , 2008.
   - CANAVOS, George, Probability and statistics, Mc. Graw Hill, 1998.

   Other supplemental materials
   - MONTOGOMERY AND DOUGLAS, Probability and statistics applied to engineering. Second Edition, Limusa, 2013.

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
   The purpose of this course is to give students knowledge about continuous and discrete probability functions.
   b. prerequisites or co-requisites. 80114 *Integral Calculus*
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

5. **Specific goals for the course**
   a. Specific outcomes of instruction.

   Students will be able to:
   - Classify data sets by differentiating characteristics that identify the types of variables.
   - Represent similar datasets using tables and graphs.
   - Identify cause-effect relationship by applying the conditional probability calculation.
   - Use discrete and continuous probability distributions to solve problems that can be associated with the usual distributions.
   - Use probability distributions to model the behavior of centralization and dispersion measurements of a set of data.

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

   (a) an ability to apply knowledge of mathematics, science, and engineering

6. **Brief list of topics to be covered**
   1. Introduction.

- Definitions of population, parameters, deterministic models, probabilistic models and sample, Basic concepts of census and sampling and Presentation of EXCEL tools

2. Descriptive statistics
   - Definition of variable and types of variables (qualitative and quantitative).
   - Definition and examples of types of qualitative and quantitative variables.
   - Description of data numerically and graphically.
   - Numerically: Frequency distributions for quantitative variables and grouped data.
   - Graphically: Diagram, frequency histograms, frequency polygon, and ogive graph, bar diagram and circular diagram.
   - Measures of central tendency (Average, Median and Fashion).
   - Quarters and Boxplot.
   - Dispersion Measures (Variance, Standard Deviation and Range).
3. Probability
   - Definition of sample space and events, Venn diagrams and event algebra, Counting sample points, Axioms of Probability, Probability of an event and equiprobable events, Independent events, Conditional Probability, Independence and Rule of Product, Total probability theorem and Bayes' Theorem.
4. Random Variables and Probability Distributions
   - Concept of random variable - Continuous probability distributions
   - Discrete probability distributions.
5. Expected value
   - Expected value and expected value properties.
   - Calculation of expected value of discrete and continuous random variables
   - Variance of a random variable and Standard Deviation.
6. Known Discrete Probability Distributions
   - Discrete Uniform Distribution - Distribution of Bernoulli - Binomial Distribution - Hypergeometric Distribution - Distribution of Poisson.
7. Known Continuous Probability Distributions
   - Uniform Distribution - Normal distribution - Applications of the Normal distribution
   - Approximation of the Binomial distribution to a Normal distribution.
   - Distribution t-studen, Distribution Chi-square, Distribution F and Distributions with Excel.
8. Fundamental Sampling Distributions and Data Descriptions
   - Random sampling.
   - Sample Distributions.
   - Distribution of the Mean and Central Limit Theorem.
   - Sampling Distribution for variance.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue course number: 81106
   Introduction to Administration

2. **Credits and contact hours**
   Credits: 2, Attendance hours: 3 hours per week, Autonomous work: 3 hours per week

3. **Text book, title, author, and year**
   - Bernal Cesar, (2014): Second Edition, Introduction to the Administration of Organizations, Bogotá, Pearson Publishing.
   - Robbins S. and Coulter M. (2010) Decima Edition, Administration. Editorial Pearson. Mexico.
   - Griffin R and Ebert R. (2005) Seventh Edition, Business. Editorial Pearson. Mexico.

     a. other supplemental materials
   - Gallo, Carmine. (2011). The secrets of Steve Jobs. Editorial Norma. Torres, Sergio: Mejia, Andres (2006) A contemporary view of the concept of management. Notebooks, v. 19 (32), pp. 111 - 134

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
   The purpose of this course is introducing students to the knowledge of administrative discipline and observation of organizational reality in national, international and global companies in order to appropriate theoretical concepts; as well as through the empirical work to visualize the complexity of the world of administration

   b. prerequisites or co-requisites. None
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. **Specific goals for the course**
   a. Specific outcomes of instruction.
      Upon completion of this course, students will be able to:
      - Understand the concepts of Management and Organizations and describe the nature of management and the importance to modern organizations of the work of managers and CEOs.
      - Describe the different types of managers that are in the levels and areas of an organization.
      - Understand the four functions of the administrative process: Planning, Organization, Direction and Control.
      - Identify the purpose and scope of the basic functional areas of a company.
   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

6. **Brief list of topics to be covered**
   - Fundamentals of administration
   - Administrative process - Planning
   - Administrative process - Organization
   - Administrative process - Control
   - Functional areas - Human Talent
   - Functional areas - Marketing
   - Functional areas - Production
   - Functional areas - Finance

6th Semester

1. **Course number and name**
   Calogue course number: 578005
   Core Curriculum Person and Culture V.

2. **Credits and contact hours**
   Credits: 3, Attendance hours: 3 per week, Autonomous work: 3 per week

3. **Text book, title, author, and year**
   - Comisión Nacional de Pastoral Familiar. Fundación Jerome Lejeune. Keys to Bioethics. Español. JMJ Rio 2013. Brasilia, 2013.
   - Congregación para la doctrina de la fe. Dignitas personae. Sobre algunas cuestiones de Bioética. 8 de septiembre de 2008. Ediciones Paulinas. 2009.
   - López Moratalla, N (2004). La realidad del embrión humano en los quince primeros días de vida. En: Revista Persona y Bioética vol. 8, núm. 21, enero-abril, pp. 6-23. Citado en: http://www.redalyc.org/pdf/832/83202102.pdf
   - Lucas Lucas, R. (2005). Explícame la Bioética. Guía explicativa de los temas más controvertidos sobre la vida humana. Ediciones Palabra. Madrid,
   - Afineevsky, E. (2015). Winter on fire: Ukraine's fight for freedom. Netflix. Claudel, P. La nieta del señor Linh .
   - Meseguer, J. (2015). España: La solidaridad de los muchos pocos. Aceprensa. Disponible en: https://www.aceprensa.com/articles/espana-la-solidaridad-de-los-muchos-pocos/Khadra, Y. El atentado.
   - Rodríguez Luño, Á. (2013). Ética personal y ética política. Publicado en eticapolitica.net. Se encuentra online en: https://www.almudi.org/articulos/8201-etica-personal-y-etica- politica.
   - Sandel, M. (2011). Justicia ¿hacemos lo que debemos? Cap. "Justicia y bien común". Barcelona: Debate.
   - Hurtado, M. y Pereira-Villa, C. (2011). Legitimidad empresarial, conflicto de tierras y producción palmera en Colombia. Revista Relaciones internacionales estrategia segura 6(2), 91-110.
   - Johnson, C. E. (2011). Organizational ethics: A practical approach. Sage Publications. Capítulo 3.
   - Narváez D., Getz I., Rest, J.R., Thoma S.J. (1999). Individual moral judgment and cultural ideologies.
   - Yarce Maya, J. (2016). Empresas éticas: Un buen negocio / Jorge Yarce Maya.
   - Zollo, L., Pellegrini, M.M., Ciappei, C. What Sparks Ethical Decision Making? The Interplay Between Moral Intuition and Moral Reasoning: Lessons from the Scholastic Doctrine

4. **Specific course information**

- Discover the way of welcoming, caring, respecting, deciding, acting and projecting human life, from conception to natural death, and that of the beings of nature, against the interventions of technoscience.
- Understand the moral dimension of your role as a citizen, in the pursuit of the common good.
- Understand and internalize a scheme of ethical reasoning to apply in the context of organizations.

a. Prerequisites or co-requisites. 578004 *Core Curriculum Person and Culture IV*.
b. Required.

5. Specific goals for the course

Develops dialogical skills and interdisciplinary work. Develops a prospective vision in the selection of solutions to bioethical challenges. Strengthens the intellectual habits of synthesis, analysis and constructive criticism. Faces bioethical problems with a secular approach. Discuss bioethical issues in a systematic way that include both local factors and the global context. Recognizes in the humanization of professional performance for the realization of Bioethics and an opportunity to improve as people. Assumes its role as a responsible citizen that contributes to the common good. Use the definition of ethics and add the criteria of the six-dimensional model of Hofstede in the formation of ethical minds for decision-making. Identify and understand a method for reasoning in ethical decision-making. It uses the four elements of the theoretical framework to make decisions in a business context and approach the concept of business legitimacy.

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

- (f) An understanding of professional and ethical responsibility.

7. Brief list of topics to be covered

- Introduction and foundations of Bioethics, forming bioethical minds. Bioethics and the beginning of life: Born. Bioethics and the care of one's life and solidarity with others: Live Bioethical elements of man's relationship with the world around him: Living together Bioethical problems at the end of life: Dying. The common good: the reason of being of the political community. The relationship between human nature and political life. The institutions of the State and of society in the construction of the common good State vs market dilemma: subsidiarity and solidarity. Corruption and service: two sides of political activity. When the use of force is justified: just war and resistance against tyranny. Ethics, culture and learning to identify ethical considerations in the real context of an organization. Ethical reasoning in the decision-making process. Development of the decision-making scheme (the ability to interpret that a situation is moral (moral perception). Decisions: which path is morally correct (moral judgment). Prioritize moral values over others (moral intention). Implement moral intention (moral behavior). Case study: Recognize, evaluate, decide and reasons to act.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue course number: 62137

   English Level 7

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - Dummett, P., Hughes, J., & Stephenson, H. (2013). Life upper intermediate:. Andover, Hampshire: National Geographic Learning.
     Gale - National Geographic Virtual Library - Gale. (n.d.). Retrieved from http://solutions.cengage.com/National-Geographic-Virtual-Library

4. **Specific course information**

a. **Brief description of the content of the course (catalog description)**
   By the end of level 7, students will demonstrate a solid understanding of written and oral texts related to the relationships and attitudes of people and animals, famous stories (movies and books), appropriate technology around the world, art expressions, development issues in developing countries, and alternative traveling. Similarly, students will produce one written composition in which they analyze and explain problems and propose solutions to diverse problematic situations around the world. Students will talk about varied topics from their own experiences and will propose solutions to worldwide issues. Students will use Information, Communication Technologies (ICT) and learning strategies to become responsible for their own learning.

b. **Prerequisites or co-requisites:** 62136 *English Level 6*

c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**,
   - Speaking. The student can explain problems and propose solutions to current problematic issues around the world.
   - Listening. The student can anticipate information to identify specific details in a conversation. The student can understand the main points of clear standard speech and relate the information to their experiences.
   - Reading: The student can show understanding of academic texts by explaining and expanding on the topics explored in the suggested texts. The students can discuss, agree and/or disagree with the topics presented in the suggested texts. Furthermore, the student can answer different type of questions (TRUE/FALSE/NOT GIVEN statement and multiple choice questions).
   - Writing. The student can write accurate and complete topic sentences and paragraphs in a problem-solution essay. The student can use connectors and linking words. Moreover, there is a wide use of appropriate grammar structures.

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

g. An ability to communicate effectively

6. Brief list of topics to be covered

- Topics: Unlikely relationships, immigration, storytelling, overpopulation.
- Vocabula related to: relationships, family influences, books and films, useful devices,nouns and phrasal verbs, problem-solving expressions.
- Grammar Structures: Mixed present and past tenses as well as future review.
- Topics: Art, grafitti, music and cultural activities, urban-social-sustainable and economic development, alternative travel, staycations, voluntourism, unusual hotels and destinations and couch surfing.
- Vocabulary related to: art, describing likes and dislikes, development nouns and adjectives, problem-solving expressions.
- Grammar Structures: gerunds and infinitives, tag questions

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue course number: 150601

   Transport Phenomena Engineering

2. **Credits and contact hours**
   Credits: 4 Attendance hours: 6 per week Autonomous work: 6 per week

3. **Text book, title, author, and year**
   - Introduction to Transport phenomena. Chapters 7, 10, 11, 13. William J. Thomson Pearson
   - Fluid mechanics. Chapters 6, 7, 8, 10, 11, 13, 15. Mott, R. Pearson
   - Heat transfer. A practical approach. Chapters 6, 7, 8 and 13. Cengel, Y. McGRAW-HILL

   Other supplemental materials
   - Heat transfer. Chapter 8. Mills A. F. McGRAW-HILL
   - Transport phenomena. Chapters 6-8, 14-16, 22-24. Bird R. B., Stewart W. E. and Lighfoot E.N.T Limusa (Second Edition)

4. Specific course information
   a. brief description of the content of the course (catalog description).

   Transport phenomena are an essential tool for the design, analysis and prediction of processes and operations in almost all the branches of engineering. Within chemical engineering they play a fundamental role in the processing of materials, phase transformations and energetic effects involved for the design of processes and products.

   The course of transport phenomena covered the study of the three laws that govern the physico-chemical principles and are called models of transport phenomena. The engineering course of transport phenomena is focused on the understanding of macroscopic phenomena of transfer of momentum, mass and energy with a complement in the understanding of how these phenomena occur at the molecular level. Important elements of the course include the development of mass and energy conservation balances, determination of temperature and concentration profiles, and the determination of transfer coefficients; all through practical problems related to chemical engineering.

   b. prerequisites or co-requisites. 21502 *Transport Phenomena*, 21405 *Mass and Energy Balance*

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. Specific goals for the course

   a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

This course requires previous knowledge on basic statistics and operation management. Upon completion of this course, students will be able to function on teams to model systems with stochastic characteristics, then the students will be able to:

- Design experiments: collect, choose and process data, using statistical tools.
- Apply the steps of a simulation study.
- Build models using specialized software.
- Evaluate alternatives and interpret the statistical analysis results to take decisions.

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

Student Outcomes

- b – ability to design and conduct experiments
- c – ability to design a system or component
- d – ability to work in groups

6. Brief list of topics to be covered

Unit 1. Transport review at the molecular level. The nature of transport phenomena. Laws of transport phenomena. Molecular transport energy in one dimension. Molecular transport of mass and momentum.

Topic 2. Fluid flow. Energy conservation. Bernoulli equation. Commercially available pipes and tubes. Loss of energy due to friction in laminar and turbulent flows. Friction factor. Series and parallel piping systems. Selection and application of pumps. Types of pumps. Flow measurement. Selection factors of a flow meter. Level measurement.

Topic 3. Packaged bed. Pressure losses in single phase flows. Countercurrent two-phase flow pressure losses. Flow in fluidized beds.

Topic 4. Convective transport in laminar and turbulent flows. External forced convection. Drag force and heat transfer in external flow. Parallel flow on flat plates. Flow through cylinders and spheres. Flow through tube banks. Internal forced convection. Average speeds and temperatures. The entrance region. General thermal analysis. Laminar flow in tubes. Turbulent flow in tubes.

Topic 5. Heat exchanger. Types of heat exchangers and main characteristics. Integral coefficient of heat transmission. Distribution of temperatures in the exchangers. Fouling factor. Analysis of exchangers. Thermohydraulic IC design.

Unit 6. Transfer of mass in interfaces. Interface transfer coefficients. Transfer of mass in a gas absorber. Transfer of heat and mass in cooling towers. Absorption of gas with chemical reactions. Fluid-solid systems. Separation membranes.

Unit 7. Transfer of mass in absorbers. Mathematical description of mass transfer rates. Specification of gas absorber diameters. Absorber design procedure.

Topic 8. Similarity analysis (1 week) Dimensional groups in molecular transport. Differential non-dimensional balances. Similarity transformations.

1. Course number and name:

Catalogue Course Number: 150602

Chemical Reaction Engineering

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   a. Fogler, H. S. *Elements of Chemical Reaction Engineering*. 4th ed. Upper Saddle River, NJ: Prentice-Hall PTR, 2006. ISBN: 9780130473943
   b. Levenspiel, O. *Chemical Reaction Engineering*. 3rd ed. New York, NY: Wiley, 1999. ISBN: 9780471254249

a. Other supplemental materials

c. Smith, J. *Chemical Engineering Kinetics*. 3rd ed. New York, NY: McGraw-Hill, 1981. ISBN: 9780070587106.

d. Steinfeld, J. I., J. S. Francisco, and W. L. Hase. *Chemical Kinetics and Dynamics*. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1999. ISBN: 9780137371235.

e. Bailey, J. E., and D. F. Ollis. *Biochemical Engineering Fundamentals*. 2nd ed. New York, NY: McGraw-Hill, 1986. ISBN: 9780070032125.

f. Stephanopoulos, G., A. Aristidou, and J. Nielsen. *Metabolic Engineering: Principles and Methodologies*. San Diego, CA: Academic Press, 1998. ISBN: 9780126662603.

5. Specific course information

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

This course applies the concepts of reaction rate, stoichiometry and equilibrium to the analysis of chemical and biological reacting systems. Derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumptions. Design of chemical and biochemical reactors via synthesis of chemical kinetics, transport phenomena, and mass and energy balances. Topics in this course include: chemical/biochemical pathways; enzymatic, pathway, and cell growth kinetics; batch, plug flow and well-stirred reactors for chemical reactions and cultivations of microorganisms and mammalian cells; heterogeneous and enzymatic catalysis; heat and mass transport in reactors, including diffusion to and within catalyst particles and cells or immobilized enzymes

b. Prerequisites or co-requisites

Prerequisites: Thermodynamics of equilibrium, Balance of matter and energy and Differential equations

c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

Required

4. **Specific goals for the course**
   a. **Specific outcomes of instruction**,
   The student will be able to:

   • Calculate the conversions of a reaction at equilibrium and enthalpy changes that accompany chemical reactions.
   • Use the concepts of chemical kinetics and experimental data correlation techniques to determine reaction rate expressions, identify the factors that affect them, and establish empirical reaction rate equations.
   • Relate the kinetic parameters of a chemical system with the phenomena observed in the laboratory and develop the mathematical relationships that govern the behavior of irreversible, reversible, serial, parallel, and multiple reactions.
   • Describe molecularly the phenomena that occur in the course of a chemical reaction, in terms of the number, type of molecules and molecular fragments that interact in the different stages of chemical reactions.
   • Examine quantitatively and qualitatively the effect of deviations from the ideal behavior of the reactors.
   • Select the reactor configuration and reactor operating mode that provides maximum benefit, taking into account market constraints, capital and operating costs, safety considerations and pollution control requirements.
   • Quantify the energy changes associated with chemical reactions and control the operation of a reactor to conduct isothermal, adiabatic or non-constant temperature controlled reactions

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
   Student Outcomes a, c, e and g

5. **Brief list of topics to be covered**
   1: Introduction to Chemical Reactors
   2: Homogeneous kinetics
   3: Ideal reactors
   4: Obtaining and analyzing speed data
   5: Multiple and non-elemental reactions
   6: Bioreactions and bioreactors
   7: Design of non-isothermal reactors

1. **Course number and name:**

Universidad de La Sabana
Course Syllabi
Chemical Engineering

Catalogue Course Number: 150604

Particle Technology and Engineering

2. **Credits and contact hours:**
   Credits: 2, Contact hours: 4, Individual work hours: 3

3. **Text book, title, author, and year**
   Introduction to Particle Technology, Martin J. Rhodes. April 2008

a. **Other supplemental materials**
   • Particle Technology and Engineering. An Engineer's Guide to Particles and Powders: Fundamentals and Computational Approaches. Seville & Wu, 20 May 2016.
   • Fundamentals of Particle Technology. R. G. Holdich. 2002.

4. **Specific course information**

a. **Brief description of the content of the course (catalog description)**
   The intent of this course is for students to learn, identify, understand and apply the phenomena governing particles and bulk solids to the design and operation of industrial processes. Aspects related to the basic principles of operation of related technologies, the state of the same, the selection criteria and some design algorithms will be considered. All of this will be studied using equations and models developed for this type of systems.

b. **Prerequisites or co-requisites**
   Prerequisites: – 21502 *Transport phenomena*

c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
   Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**,
   The student will be able to:
- Understand the fundamentals governing the characterization and performance of particulate systems.
- Critically analyze situations involving particle and bulk solids handling
- Propose solutions that will improve the efficiency of equipment and processes

b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
- Student Outcomes A, B and G

6. **Brief list of topics to be covered**

- What is particle technology and what are particles
- What is known
- What are the applications
- Shape: Basic measurement and Shape factor
- Size: Definitions, Functions, Measurement methods and Distribution
- Density: Solid density, Bulk density, Tapped density, Void fraction and porosity
- Surface area
- Flowability: Angle of repose, Angle of spatula, Hausner ratio, Carr Index, flow meters and powder rheometers.
- Compresibility: Heckel equation, Kawakita equation and Adams equation
- Compactability
- Motion of Solid Particles in a Fluid
- Settling of a single particle in a fluid
- Drag Force
- Particle terminal velocity
- Non-Spherical Particles
- Effect of Boundaries on Terminal Velocity
- Settling of a Suspension of Particles
- Hindered systems: settling and zone theory
- Batch Settling
- Pressure drop –vs- flow relationship
- Fluidization: minimum fluidization velocity, bubbles and types of fluidization
- Filtration
- Crushing, grinding and milling: classification and breakage/crushing laws
- Solid-solid mixing: types, equipment and cohesive powder mixing
- Friction and the Coloumb model
- Stress analysis and storage in vessels
- Stress analysis for compression of a powder bed
- Discharge dynamics: Hopper and silo flow, angle design and powder flow function.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue course number: 21802
   Economical Engineering

2. **Credits and contact hours:**
   Credits: 2, Contact hours: 2, Individual work hours: 4

3. **Text book, title, author, and year**
   - Bacca Guillermo, 2011, Ingenieria Economica, Bogotá, Panamerican Educational Fund .
   - Anaya Hector,2012, Final Analysis, Bogotá, Editorial University Externado of Colombia 14 Edition .

4. **Specific course information**

a. **Brief description of the content of the course (catalog description)**
   The purpose of this course is to give students the knowledge for understand, develop and apply practical cases in which apply the acquired knowledge on the management of financial mathematics combined with accounting concepts, so that later can integrate in the development of the proposed cases of practical type that allow the decision making.

b. **Prerequisites or co-requisites:None**

c. Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**,
   With the development of the course the student acquires knowledge regarding interest rate in its different versions, form of acquisition and cancellation of credits, methods and places of acquisition of such financing; Structure of financial statements (balance sheet, income statement, cash flow), organization, analysis and interpretation of the information provided by these financial statements and the application of indicators; Finally, the organization and application of the cash flows, the use and application of the methods of valuation of Projects and the decision making based on the obtained results.

b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
   - e - An ability to identify, formulate, and solve engineering problems.
   - h - The broad education necessary to understand the impact of engineering solutions in

6. **Brief list of topics to be covered**
   - Simple interest rate, Types of Discounts, partial payments, value equations.
   - Compound interest rate, effective rate, nominal rate, equivalent rate, devaluation, inflation, combined rates, investments in foreign currency.
   - Annuities, gradients, amortization, capitalization, cash flow, VPN, IRR, CAUE.

7th semester

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 150701
   Separation Processes and New Technologies

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   Separation Process Engineering. Philip C. Wankat. Prentice Hall. 2011.

a. Other supplemental materials

• Operaciones Unitarias en Ingeniería Química. Warren L. McCabe, Julian C. Smith, Peter Harriot. McGraw Hill. 1998.
• Procesos de Transporte y Operaciones Unitarias. G.J Geankoplis. 1998
• Separation Process Principles. J.D Seader, Enerst J. Henley, D. Keith Roper. John Wiley & Sons, Inc. 2011.
• Operaciones de Transferencia de Masa. Robert E. Treybal.

4. **Specific course information**

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

- The intent of this course is for students to size separation equipment to recover and purify substances of interest, subjected to technical, security, environmental and economic constraints.

b. Prerequisites or co-requisites
Prerequisites: 21502 – Transport Phenomena

c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
Required

5. **Specific goals for the course**

a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
The student will be able to:

- Gain an understand of the mechanisms of transfer.
- Highlight the importance of the mass transfer operations which are fundamental and characteristics of chemical engineering.
- Identify the main characteristics of the equipment used in the different operations and the influence of the most important variables on its operation.
- Develop different design methods, trying to keep the overview of each of the operations and establishing the similarities and differences between them.

- Manage the basics of the various operations using systems as simple as possible, leaving the resolution of the most complex problems to the use of simulators as ASPEN.
- Understand the basic concepts necessary for the selection of the most appropriate separation operation in each case, especially from an energy point of view.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. (según Tabla ABET)

- Student Outcomes B, C, I and K

6. Brief list of topics to be covered

- Introduction to separation Processes

Distillation

- Binary and multicomponent flash distillation
- Binary distillation. Internal balances, Lewis method, McCabe-Thiele method, limit conditions, Murphree efficiency, simulation process, reflux calculations, intermediate reboiler and condenser, open heat steam.
- Multicomponent distillation. Approximate Shortcut methods (Fenske, Gilliland, Underwood)
- Complex distillation process. Reactive distillation, azeotropic distillation, extractive distillation, pressure-swing distillation, steam distillation.
- Tray and packed column design
- Distillation economics. Cost estimation and energy conservation.

Absorption and stripping

Liquid-Liquid extraction

- Liquid-Liquid extraction equipment
- Immiscible Liquid-Liquid extraction. Cross-flow and countercurrent operations.
- Miscible Liquid-Liquid extraction. Single stage, cross-flow, and countercurrent operations.

Leaching and washing

- Leaching and washing equipment
- Washing. Porosity, cross-flow and countercurrent operations.
- Leaching. Single stage, cross-flow, and countercurrent operations.

New technologies in separation processes

- Membrane processes. Gas permeation, reverse osmosis, ultrafiltration, pervaporation
- Last tendencies in separation processes.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Catalogue course number 150702
   Product and Process Design I

2. **Credits and contact hours**
   Credits: 3 Attendance hours: 4 per week Autonomous work: 5 per week

3. **Text book, title, author, and year**

- Rosenau M Jr, Griffin A, Castellion G, Anschuetz N, eds. The PDMA handbook of new product development. New York: John Wiley & Sons, Inc., 1996.
- Dym C, Little P. Engineering design: a project-based introduction. New York: John Wiley & Sons, Inc., 2000.
- Otto K, Wood K. Product design-techniques in reverse engineering and new product development. Upper Saddle River: Prentice Hall, 2001.

other supplemental materials

- Cagan J, Vogel C. Creating breakthrough products. Upper Saddle River: Prentice Hall, 2002.
- Ulrich K, Eppinger S. Product design and development. 3rd ed. New York: McGraw Hill, 2003.

4. **Specific course information**
   a. brief description of the content of the course (catalog description).

   To develop in the student the skills to create, innovate, design and understand processes and products in chemical engineering, involving technical, economic, environmental, ethical and social aspects that contribute to the integral development of the society in which it is immersed.

   To enable the student to make a product design involving stages such as: market analysis, recognition of quality factors, engineering properties and performance indicators, formulation of their formulation (property functions); as well as producing a preliminary design for the production process that includes the different stages of the process and the sizing of the most relevant equipment.

   b. prerequisites or co-requisites: 150602 *Chemical Reaction Engineering*

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. **Specific goals for the course**

   a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

This course requires previous knowledge on basic statistics and operation management. Upon completion of this course, students will be able to function on teams to model systems with stochastic characteristics, then the students will be able to:

- Design experiments: collect, choose and process data, using statistical tools.
- Apply the steps of a simulation study.
- Build models using specialized software.
- Evaluate alternatives and interpret the statistical analysis results to take decisions.

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

Student Outcomes C, G, H, I, and J

6. Brief list of topics to be covered

MODULE I. PRODUCT DESIGN

1. Introduction to Product Design: Classification of Chemicals, Design Opportunities. Steps for the design of products and processes. Environmental Protection. Safety Considerations. Ethics in engineering. Role of technological aids. 2. The design process: Methodologies (FFE, SGPDP and others), Product Design with Design Thinking (TALLER) 3. Chemical Product Definition: the chemical product pyramid, Chemical Product Segmentation, New product development -vs- product concept design, design phases of chemicals. 4. Customer needs: Market identification, market needs identification, transformation of market needs to engineering specifications, VOC (KANO) 5. Description of concepts: Segmentation of chemical products, the chemical product pyramid, Sheet construction mission, value proposition. 7. Quality factors and performance indexes: Conjoint Analysis, House of Quality, Quality Function Deployment (QFD), benchmarking 7. Generation and selection of ideas: Decomposition of the design problem, Internal search and external search, literature analysis, techniques for the generation of ideas, methodologies of creativity, CAMD, methods of contribution. Classification tree, TRIZ and Pugh matrix 8. Final specifications: how to establish them, Quality factor -vs- property function, cost model development, benchmarking, QFD and HoQ.

MODULE 2. . PRELIMINARY PROCESS DESIGN 9. Preliminary process design for commodity products Preliminary creation of the databases. Experiments. Preliminary synthesis of the process. Development of the base design case.10. Preliminary process design for special products Preliminary creation of the databases. Experiments. Preliminary synthesis of the process. Development of the base design case.11. Simulation to assist the creation of processesPrinciples of steady state process simulation. Study cases. Principles of batch process simulation.12. Heuristic for the synthesis of processes Raw materials and chemical reactions. Distribution of reagents. Separations. Removal or addition of heat to reactors. Heat exchangers and ovens. Pumping, compression, pressure reduction, vacuum and cost model, benchmarking, QFD and HoQ.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**
   Course Catalogue 150703
   Biotechnology

2. **Credits and contact hours**
   Credits: 3 Attendance hours: 7 per week Autonomous work: 2 per week

3. **Text book, title, author, and year**
   - Biotechnology for engineers: biological systems in technological processes / comp. by Alan Scr
   - Biotechnology and introduction / Susan R. Barnum.
   - Lehninger: Principles of Biochemistry / David L. Nelson and Michael M. Cox; Translation coordinator
   - Biochemistry / Christopher K. Mathews, K. E. van Holde, Kevin G. Ahern; tr. José Manuel González d
   - Brock: biology of microorganisms / Michael T. Madigan, John M. Marko and Jack Parker; trad
   - Biology / Helena Cur s and N. Sue Barnes; editing direction Adriana Schnek and Graciela Flores.

   Other supplemental materials
   - Brock biology of microorganisms / Michael T. Madigan, John M. Martinko and Jack Parker.
   - Lehninger: Principles of Biochemistry / David L. Nelson and Michael M. Cox; Translation coordinator
   - Biochemistry / Christopher K. Mathews, K. E. van Holde and Kevin G. Ahern; Translation and Localization Syllabus.

4. Specific course information
   a. brief description of the content of the course (catalog description).

In this subject students are expected to understand the role of the Chemical Engineer in Biotechnology and seeks to generate competencies of an engineer for the design of processes
* Identify the role of the Chemical Engineer in the field of Biotechnology and the importance of interdisciplinarity in research development.
* Know and understand the scientific fundamentals of biotechnological processes.
* Show the importance of biotechnology in the valuation, use and transformation of the country's biodiversity.
* To know the basic principles of the fundamental biotechnological processes like handling of microorganisms, fermentations, scaling, obtaining and purification of products.
* Establish the state of the art of the various areas of biotechnology.

b. prerequisites or co-requisites.
c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: No Required.

5. Specific goals for the course

This course requires previous knowledge on basic statistics and operation management. Upon completion of this course, students will be able to function on teams to model systems with stochastic characteristics, then the students will be able to:

- Design experiments: collect, choose and process data, using statistical tools.
- Apply the steps of a simulation study.
- Build models using specialized software.
- Evaluate alternatives and interpret the statistical analysis results to take decisions.

a. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Student Outcomes A , B and H

6. Brief list of topics to be covered

Current and future panorama of biotechnology in the world. Current development of biotechnology in Colombia and its perspectives. Legislation, intellectual property and biodiversity. Cell growth in batch culture. Influence of environmental factors. Model of Monod. Specific growth rate. Mechanisms of DNA replication. Mutations spontaneous and induced. Mechanisms of DNA repair. Transcription in prokaryotic and eukaryotic cells. Splicing. Regulation of the transcription.Genetic code. stages and transductional modifications. Exceptions to the central dogma of molecular biology. Virus. Classification and use in biotechnological processes. Introduction to Bioinformatics ca. Biological databases Techniques in molecular biology. Hybridization, sequencing, PCR, cloning and expression. The era of omics: genomics, transcriptomics, proteomics, metabolomics, metagenomics. Nanotechnology. Developments based on living beings. Applications in biological systems - functionalization. Antibodies. Introduction to Biochemical Engineering. Elemental composition of cells. Factors of yield. Stoichiometry. Stoichiometric balance by the available electron method. First and second law of thermodynamics in biological processes. Factors of energy yield in biomass. True substrate yield in biomass. Coefficient of maintenance. Kinetics of growth in cultivation per batch fed. Kinetic growth models in cultive with nuo. Single chemostat. Fermentation strategies using cultive with nuo. Recirculation. Bioreactors in series. Bioreactors with immobilized cells and enzymes. Types of immobilization. Bioseparations. Basic operations of separation: Centrifugation, cellular rupture. Filtration. Sterilization of cultive media. Wet heat sterilization. Filtration.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue course number: 21702
   Entrepreneurship and business creation

2. **Credits and contact hours:**
   Credits: 2, Contact hours: 2, Individual work hours: 4

3. **Text book, title, author, and year**
   - Varela Rodrigo, 2008 "Business Innovation: Art and Science in Business Creation"
   - Ponti, Franc. Xavier y Ferrás, Xavier. Passion for Innovation. Group Editorial Norma. 2006.

   Other supplemental materials
   - Wagner, Tony. CREATE INNOVATIVES. Rule. 2012
   - Three of Bes. Fernando and Philip Kotler. Innovate to win. The ABCDEF model. Active company. 2011.

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**
      The purpose of this course is to encourage students to develop entrepreneurial, innovative and creative skills and competences that allows them to be applied in the creation and start-up of new companies, ventures of a social or cultural nature
   b. **Prerequisites or co-requisites:** None
   c. Elective

6. Specific goals for the course

a. Specific outcomes of instruction,
- Integrate in a critical and reflexive way the different previous knowledge acquired in his career from the basic sciences, disciplines and research for the development of Basic - Humanistic projects.
- Formulate and evaluate interactive projects in a critical and reflexive way with the environment.

a. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
- (h) ability to recognize the impact of engineering solutions

7. Brief list of topics to be covered
- General concepts of business, work, family. Motivations and incentives by which people move and live. The entrepreneurial spirit, innovative and creative. Personal and relational Leadership Team leadership.
- CASE analysis: Apple, Google, 3M, El Bulli, Cirque du Soleil and others.
- 2 Study of people who have developed a great entrepreneurial or social spirit

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue course number 21701
   Grade project seminar

2. **Credits and contact hours:**
   Credits: 1, Contact hours: 1, Individual work hours: 2

3. **Text book, title, author, and year**
   Supplementary course material is available at Virtual Sabana -Online system (http://virtual.unisabana.edu.co/course/view) for students registered for the course

4. **Specific course information**

a. **Brief description of the content of the course (catalog description)**
The objective of the Seminar Degree Project is to develop the student's critical ability and ability to solve problems. This objective is fulfilled by the student's identification and treatment of a research problem within the chosen area of study. The course should develop the student's knowledge about, and an understanding of, how to independently plan, conduct and present a scientific report. In addition, the course should develop the student's ability to critically scrutinize and assess investigations as well as research papers.

b. **Prerequisites or co-requisites:** None

c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**,
- Can identify an analytic review of the relevant literature
- Can identify researchable hypotheses
- Can distinguish between quantitative and qualitative methods
- Can identify the selection of research methods exploring one's research question or hypothesis.
- Can identify the importance of writing process

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
- (e) An ability to identify, formulate, and solve engineering problems

6. **Brief list of topics to be covered**

- In this module, students will understand the research cycle and how to generate possible researchable questions. In addition, students will be gaining and understanding of the differences between research methods and design. The philosophical difference between qualitative and quantitative design will be presented.
- In this module, students will be completing the review of the literature and formalizing their research questions and hypotheses.
- In this module, students will understand the importance that has writing process as strategy to spread knowledge. Ethics and the use or misuse of research will be presented

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue course number: 21902
   Project engineering

2. **Credits and contact hours:**
   Credits: 2, Contact hours: 2, Individual work hours: 4

3. **Text book, title, author, and year**
   - Miranda, Juan José, 2012. Project management. MM Publishers.
   - Mokate, Karen, 2004. Financial evaluation of investment projects. Uniandes.
   - Mokate, Karen, 2003. Economic and social evaluation of investment projects. Uniandes.

a. **Other supplemental materials**
   - Serrano, Javier. 2013. FINANCIAL MATHEMATICS AND PROJECT EVALUATION. Uniandes.
   - Prieto H., Jorge Eliécer, 2014. Projects: Managerial approach. Ecoe Editions.

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**
      The purpose of this course is to give students the course will provide the student with the criteria for the formulation and evaluation of an engineering project, indispensable during his professional life. These criteria are interdisciplinary, in that, it will value the work in multidisciplinary teams. These criteria including market, process, environment, ethical, and social topics.
   b. **Prerequisites or co-requisites:** 21802 Economical Engineering
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**,
   Upon completion of this course, students will be able to:
   - Recognizes the existence of ethical issues in engineering practice.
   - Executes a financial evaluation of an engineering project.
   - Recognizes the globalization and its influence on the development of an engineering project.
   - Identifies and incorporates into the decision-making process, the potential environmental impacts that may generate an engineering project.
   - Identifies and incorporated into the decision-making process the potential social impacts that can generate an engineering project.

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

- (d) an ability to function on multidisciplinary teams
- (f) An understanding of professional and ethical responsibility.
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

6. Brief list of topics to be covered

1. Conceptualization of investment projects:
    - Stages of the project.
    - Environment of the project.
    - Components of a project.
2. Definition of the project idea
3. Market study
    - Analysis of the demand, competition and price for the product or service.
    - Commercial strategy.
    - Sales projection.
4. Technical study
    - Definition of the production model, location and size of the project.
    - Estimation of costs.
5. Administrative study
    - Definition of the organizational structure and management model.
    - Definition of corporate governance and strategic planning model.
6. Environmental and social study
    - Environmental impact and mitigation analysis.
    - Definition of the social responsibility model.
7. Legal study
    - Legal framework of a project.
    - Legal forms of an organization.
8. Financial study
    - Structure of a cash flow.
    - Financial indicators of a project.

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name**

   Catalogue course number: 21106

   Introduction to Programming.

2. **Credits and contact hours**

   3 credits – 4 Contact hpurs – 5 Independent work

3. **Text book, title, author, and year**
   - No guide book is followed
   - other supplemental materials
   - Fundamentos de programación, aprendizaje activo basado en casos. Villalobos y Casallas. Pearson Editores.
   - Programación en Java 7. Luis Joyanes. McGraw Hill editores.
   - Java how to program by Deitel & Deitel. Prentice Hall editors.
   - Head First Object-Orientes Analysis and Design by Brett D. McLaughlin. Oreilly editors.

4. **Specific course information**
   a. brief description of the content of the course (catalog description).
   - This course aims to develop the basic skills inherent to learning and applying the logic of programming. The essential theme is the recognition of the basic logic structures of programming around the concepts of sequentially, conditionality, repeatability or cyclic task and some basic data structures.

   b. prerequisites or co-requisites. None
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

5. **Specific goals for the course**

   Specific outcomes of instruction, ex.
   - Develop capacities for algorithmic reasoning and for the development of basic programs in an object-oriented language.
   - Identify, formulate and solve engineering problems that require programming of computational devices.
   - They will be competent in perform the analysis and design of computer programs of basic complexity.

   Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   - (e) an ability to identify, formulate, and solve engineering problems
   - (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

6. **Brief list of topics to be covered**
    1. Algorithms and design
        a. The concept of process
        b. Sequentially
        c. Simple conditionality
        d. Nested conditionality
    2. Programming Fundamentals
        a. Variables in Java
        b. Input and output in Java
        c. Conversion of data type in Java
        d. Mathematical, relational and logical operations in Java
        e. The Math classes
        f. The String classes
        g. Programming logical structures in Java
    3. Basic data structures
        a. Static arrangements one dimension
        b. Static arrangement two dimensions

8th semester

1. **Course number and name:**
   Catalogue Course Number: 150803
   Products and Process Design II

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - Product and Process Design Principles, 3rd ed., Seider, Seader and Lewin. Wiley Press. 2008

   Other supplemental materials
   - Chemical Engineering Design, 4th ed., R.K. Sinnott. Butterworth-Heinemann. Elsevier 2005
   - Analysis, Synthesis and Design of Chemical Process, 3rd ed., R. Turton, R. Baillie, W. Whithing, J. Shaeiwitz. Prentice Hall. 2009
   - Rules of Thumb for Chemical Engineers, 4th ed, C. Branan. Gulf Professional Publishing, Elsevier. 2008
   - Applied Process Design for Chemical and Petrochemical Plants, Vol I, II, III, Ernest Ludwig. Gulf Professional Publishing. 2001
   - Manual del Ingeniero Químico, Perry, 6th Ed, Mc Graw Hill. 1992
   - Chemical Process Equipment. Select and Design, 3rd ed., St. Walas, Butterworth, 1998
   - Conceptual Design of Chemical Processes, J.M. Douglas, Mc Graw Hill, 1988

4. **Specific course information**

a. **Brief description of the content of the course (catalog description)**
   The goal of course is synthetizes chemical engineering process applying mathematical modeling of process and equipment units through calculational strategies based on economic evaluation and optimization. The designs are supported with technological tools such as process simulators (ASPEN, Promax).

b. **Prerequisites or co-requisites**
   Prerequisites: 150702 – Product and Process Design I, 150503 – Materials and Nanomaterials Science

c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
   Required

5. Specific goals for the course

a. Specific outcomes of instruction

The student will be able to:

- Apply knowledge of mathematics, science, and engineering
- Design and conduct experiments, as well as to analyze and interpret data
- Design a system, component, or process to meet desired needs within constraints economics, environmental, socials, , ethical, health and safety, manufacturability, and sustainability
- Operate on multi-disciplinary teams
- Identify, formulate, and solve chemical engineering problems
- Understanding of professional and ethical responsibility
- Communicate effectively technical and personal information obtained from designs
- Recognize the impact of engineering solutions in a global, economic, environmental, and social context
- Use the capacity in self learning to solve engineering problems
- Recognize the contemporary issues and its relationship with his profession
- Use the techniques, skills, and modern engineering tools necessary for chemical engineering practice.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. (según Tabla ABET)

- c - Design a system, component, or process to meet desired needs within constraints economics, environmental, socials, ethical, health and safety, manufacturability, and sustainability
- d - Operate on multi-disciplinary teams
- h - Recognize the impact of engineering solutions in a global, economic, environmental, and social context
- i - Use the capacity in self learning to solve engineering problems

6. Brief list of topics to be covered

- Product design. Innovation maps. Properties estimation.
- Ethics in chemical engineering.
- Process design. Process simulation. Heuristics.
- Profitability analysis of process.
- Heat exchangers, separations, pumps and compressors, reactors. Design, optimization, pressure drop.
- Process troubleshooting
- Process optimization. Design of experiments. Response surface

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 150801
   Process Control and Dynamics

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - Book, Process Dynamics and Control, D. Seborg John Wiley & Sons, 2010
   - Book, Control Automático de Procesos. Teoría y Práctica C.A., Smith, A.B. Corripio Limusa-Wiley, 2010

   Other supplemental materials
   - Process Control Design and Simulation, B. Weyne Bequette Prentice Hall, 2003
   - Feedback and Control Systems, DI STEFANO III, STUBBERUD, WILLIAMS,1976
   - Automatic Control Systems, KUO, B.C, 1995
   - Process Dynamics, Modeling and Control, OGUNNAIKE B.A, 1994
   - Process Control: Designing processes and control systems for dynamic performances, Tomas E Marlin, 2000

4. **Specific course information**

   a. **Brief description of the content of the course (catalog description)**
   Three major modules are contemplated within this program with the purpose of giving the student the possibility of knowing the basic and advanced strategies of the control of chemical processes: The dynamic mathematical description of a process to quantify possible effects of external variables in the process; the corresponding instrumentation involved in the process control and automatization and the techniques of parameter adjustment to obtain a good performance of the designed control strategy. At the end of the course, the student will be able to choose and design adequate control systems for different chemical processes, using mathematical and engineering tools, and choose the appropriate instrumentation to ensure the correct operation of the process.

   b. **Prerequisites or co-requisites**
   Prerequisites: 150602 – Chemical Reaction Engineering

   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
   Required

5. **Specific goals for the course**
   a. **Specific outcomes of instruction**, ex. The student will be able to explain the significance of current research about a particular topic.
   The student will be able to:

- Model chemical processes through differential equations based on matter and energy balances, chemical equilibrium, chemical reactions, heat transfer, and fluid flow.
- Identify and design strategies of feedback and feedforward control with its instrumentation
- Use the concepts of Laplace transform and transfer function to evaluate the dynamic response at different inputs
- Use block diagramming and algebra to summarize and graphically represent control strategies of a process.
- Apply linearization strategies of chemical process functions of one or more variables
- Choose and design the type of controller for the process under study and establish the response of the system by calculating the maximum gain and last period.
- Analyze and interpret control schemes in chemical plants.

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

- a - Applies knowledge of science, mathematics and engineering
- e - an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- k - an ability to identify, formulate, and solve engineering problems

6. Brief list of topics to be covered

Introduction and Dynamic behavior of chemical processes

- Matter and energy balances of chemical processes
- Dynamic responses of typical chemical processes under different inputs
- Linearization strategies with Taylor series
- Laplace transformation
- Block diagram and algebra
- Stability and state space model

Control loops design

- Dynamic responses of first and second systems
- Empirical models
- Higher orders systems
- PID Controller
- Last gain and last period. RLocus. Diagrams of Bode and Nyquist.

Advance control system

- Tuning
- Dynamic systems of higher order
- Feedforward control

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 150801
   Modelling and Simulation in Chemical Engineering

2. **Credits and contact hours:**
   Credits: 3, Contact hours: 4, Individual work hours: 5

3. **Text book, title, author, and year**
   - SCENNA N. J., Modelado, Simulación y Optimización de Procesos Químicos. Libro electrónico: http://www.modeladoeningenieria.edu.ar/libros/modeinge/modinge_f.htm
   - LUYBEN W.L. Process modeling, simulation and control form chemical engineers. Segunda edición. Mc Graw-Hill. 1990
   - SEIDER W.D. , SEADER J. D. , LEWIN, D.R. , Process design principles : synthesis, analysis and evaluation John Wiley & Sons, New York 2004.
   - DE LA CUESTA, P. J., MARTINEZ, E. R. Operaciones de Separación en Ingeniería Química. Pearson-Prentice Hall. (2004).
   - PRAUSNITZ, J; ANDERSON, T; & GRENS, E. Computer Calculations for Multicomponent Vapor – Liquid and Liquid – Liquid Equilibria. PRENTICE HALL. Englewood Cliffs. (1980).
   - KREYSZIG. "Matemáticas Avanzadas para Ingeniería". Vol II. Editorial Limusa
   - PETLYK, F. B. Distillation theory and its application to optimal design of separation units. Cambridge Series in Chemical Engineering. (2004).
   - TAYLOR, R., KRISHNA, R. Multicomponent mass transfer. JOHN WILEY & SONS, INC. (1993).
   - BIRD, R. B., STEWART, W. E., LIGHFOOT, E. N. Fenómenos de transporte. Reverte. (1970).
   - L. S. PALATNIK & A. I. LANDAU. Phase Equilibria in Multicomponent Systems. HOLT, RINEHART AND WINSTON, INC. (1964).
   - Revistas: AIChE Journal, Chemical Engineering, Chemical Engineering Science, Industrial & Engineering Chemistry, Computers Chem. Eng., Chemical Engineering Process. Book, Process Dynamics and Control, D. Seborg John Wiley & Sons, 2010

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**

In the Chemical Industry millions of dollars are spent on research, much of this capital is used in experimentation either on a laboratory scale or pilot plants. In recent years, and due in large part to the development of increasingly powerful and economical computers, the simulation of Chemical Engineering processes has taken a great deal of strength and acceptance among researchers.

It is necessary that the Chemical Engineer can develop, solve and apply different characteristics of modeling and simulation of processes.

   b. **Prerequisites or co-requisites**

Prerequisites: 150602 – Chemical Reaction Engineering

c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

Required

5. Specific goals for the course

a. Specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

The student will be able to:

- Model chemical processes through differential equations based on matter and energy balances, chemical equilibrium, chemical reactions, heat transfer, and fluid flow.
- Identify and design strategies of feedback and feedforward control with its instrumentation
- Use the concepts of Laplace transform and transfer function to evaluate the dynamic response at different inputs
- Use block diagramming and algebra to summarize and graphically represent control strategies of a process.
- Apply linearization strategies of chemical process functions of one or more variables
- Choose and design the type of controller for the process under study and establish the response of the system by calculating the maximum gain and last period.
- Analyze and interpret control schemes in chemical plants.

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

- d - An ability to function on multidisciplinary teams.
- i - A recognition of the need for, and an ability to engage in life-long learning.
- k - an ability to identify, formulate, and solve engineering problems

6. Brief list of topics to be covered

- Introduction
- General, historical review.
- Thermodynamic and transportation properties
- Basic unit operations
- Lines of pipes
- Chemical reactors
- Heat exchangers
- Design of heat exchange networks
- Distillation
- Extractive distillation
- Reactive distillation
- Economic analysis
- Process control

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue Course Number: 150804
   Health, safety and Environment.

2. **Credits and contact hours:**
   Credits: 2, Contact hours: 3, Individual work hours: 5

3. **Text book, title, author, and year**
   - D. Crowl and J. Louvar, Chemical Process Safety: Fundamentals with applications, Second Edition ed. United States of America: Prentice Hall International, 2002.
   - AICHE and CCPS, Guidelines for chemical process quantitative risk analysis. New York, 2000.
   - López Carrizosa, F.J. El sistema de gestión integrado. Bogotá, ICONTEC, 2009
   - OHSAS, OHSAS 18001: Sistema de gestión en seguridad y salud ocupacional: Requisitos, ed, 2007
   - Decreto 1072 de 2015.

   Other supplemental materials
   - CCPS, Tools for making acute risk decisions with chemical process safety applications. New York: AICHE, 1995.
   - ICONTEC, "Normas y documentos de apoyo para la implementación, mantenimiento y mejora de los sistemas de gestión ambiental".
   - AICHE and CCPS, Guidelines for developing quantitative safety risk criteria. Hoboken, N.J.: J. Wiley, 2009.
   - Resolución 2400 de 1979.
   - Manual de Higiene Industrial de Mapre . 2001.
   - Norma Técnica Colombiana. NTC – 1523. Higiene y seguridad. Cascos de seguridad industrial.
   - OSHA 29 CFR 1910.135.

4. **Specific course information**
   a. **Brief description of the content of the course (catalog description)**
      The main objective of the course is to provide students all tools and information that they need to know and learn about occupational safety and safety process, supporting methodologies and concepts related to Occupational Health and Safety, Quality and the Environment, as well the analysis of cases studies based in real chemical accidents. Topics are also uncovered in the risk assessment from the operational part to the industrial process control.
   b. **Prerequisites or co-requisites:** 150603 Chemical Engineering Seminar
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.** Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**, ex. The student will be able to explain the significance of current research about a particular topic.
   - Recognize the importance of occupational health and industrial hygiene in the workplace, as well as identify professional risk factors and establish their relationship with industrial safety, guided by international / national regulations (ISO 18001).
   - Interpret and apply the fundamentals of quality in integrated management systems, according to ISO 9001, to ensure effective management in organizations.
   - Identify the most relevant environmental aspects that have an impact on health and the environment, establishing a relationship with the current national legislation and develop competencies and skills for the implementation of environmental management systems based on the ISO 14001 standard.
   - Understand and use basic process security tools to evaluate specific accidental scenarios, through the implementation of hazard identification techniques and consequences analysis.

b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
   - g – Communication.
   - e – Solve Problems, Ethics, Contemporary
   - h – impact of solutions
   - j – contemporary issues

6. **Brief list of topics to be covered**
   - Occupational health and its importance
   - Risk factors and their classification
   - Basics of industrial safety
   - National and international regulatory framework.
   - Concept and evolution of quality
   - Foundations of integrated management systems
   - ISO 9000 standards
   - Introduction to process safety
   - Mechanical Integrity
   - PHA Techniques
   - Out of control reactions
   - Analysis of consequences
   - Environmental pollution and its effects
   - National environmental legislation
   - Sustainable processes and cleaner production
   - Environmental management system (ISO 14001 standard)
   - Natech

Universidad de La Sabana
Course Syllabi
Chemical Engineering

Universidad de La Sabana
Course Syllabi
Chemical Engineering

1. **Course number and name:**
   Catalogue course number: 12939
   Internship Seminar

2. **Credits and contact hours:**
   Credits: 1, Contact hours: 2, Individual work hours: 0

3. **Text book, title, author, and year**
   - Amaya Rodríguez, L., & Chona Niño, M. C. (2017). Ruta Sabana a la vida profesional. Chía: Editorial Kimpres.

   a. **Other supplemental materials**
   Communication workshops, leadership workshops, Assessment center

4. **Specific course information**

a. **Brief description of the content of the course (catalog description)**
The purpose of the internship seminar is to provide tools to help students to have a successful approach and adaptation to the professional field. The course covers different topics, that will prepare the student for the transition between academy and a full-time job, related to the preparation of professional internship such as life project, how to make a resume, selection processes, etc.

b. **Prerequisites or co-requisites.** 62137 *English level 7*

c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program**
Required

5. **Specific goals for the course**

a. **Specific outcomes of instruction**,
Upon completion of this course, students will be able to:
- Develop curriculum vitae according to their profile and interests.
- Understand and be able to present and develop each step of a job application process.
- Develop key professional skills to have a successful transition to its internship.

b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
- (g) An ability to communicate effectively
- (i) A recognition of the need for, and an ability to engage in life-long learning
- (j) A knowledge of contemporary issues

6. **Brief list of topics to be covered**

1. Internship department presentation
2. Objectives of the seminar
3. Engineering faculty Internship Regulation
4. Key dates: events, due dates, etc.
5. Defining professional career path
    - Know yourself: strengths and opportunities
    - Leadership
    - Create consciousness of preferences and values
6. Curriculum Vitae
    - Sections of a curriculum vitae
    - How to design your CV
    - Skills identification
7. Job application process
    - Application process tips
    - Job application steps
    - Interview
    - Psychotechnical tests
    - Applied Assessment experience
8. Communication skills
    - Verbal communication
    - Nonverbal communication
9. Professional skills
    - Team work
    - Networking
    - Time management
    - Emotion management
10. Guidelines for internship development
    - Workplace safety, security and health
    - Employment contract
    - Internship project
11. Internship outcomes, guidelines and dates

Universidad de La Sabana
Course Syllabi
Chemical Engineering

9th semester

1. **Course number and name**
   Catalogue Course number: 211001
   Professional Internship

2. **Credits and contact hours**
   Credits: 16, Attendance hours: 0 per week, Autonomous work: 40 per week

3. **Text book, title, author, and year:** none

4. **Specific course information**
   a. brief description of the content of the course (catalog description).

   Strengthened and implemented acquired knowledge through study classes in a real environment. The idea of this course is that student can apply: entrepreneurial vision, analysis capacity, work in team, development of recursion, leadership, solve different types of problems (own and engineering problems)

   b. prerequisites or co-requisites. 12939 Internship Seminar

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required.

5. **Specific goals for the course**

   a. Specific outcomes of instruction.

- Professional outcomes: analysis capacity, proactivity, ideas generation, identification and solve problem, planification and work organization, team work, leadership.
- Communication outcomes: Verbal fluency, properly use of different communication channels on the company, good argumentation of different ideas
- Socio-emotional outcomes: Concern and integration on the work area, ability to work under pressure, tolerance, good information uses, use of different difficulties of labral environment.

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

- b. An ability to design and conduct experiments, as well as to analyze and interpret data.
- d. An ability to function on multidisciplinary teams.
- e. An ability to identify, formulate, and solve engineering problems.
- f. An understanding of professional and ethical responsibility.

- g. An ability to communicate effectively
- h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- i. A recognition of the need for, and an ability to engage in life-long learning
- j. A knowledge of contemporary issues
- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

6. Brief list of topics to be covered

During the semester, the students must assist to four conferences to cover different topics about the work life, development and strengthened of professional outcomes. On the other hand, during this period, the student must develop a project in to the company, whose goals is improving and optimize a specific area or job in the company.