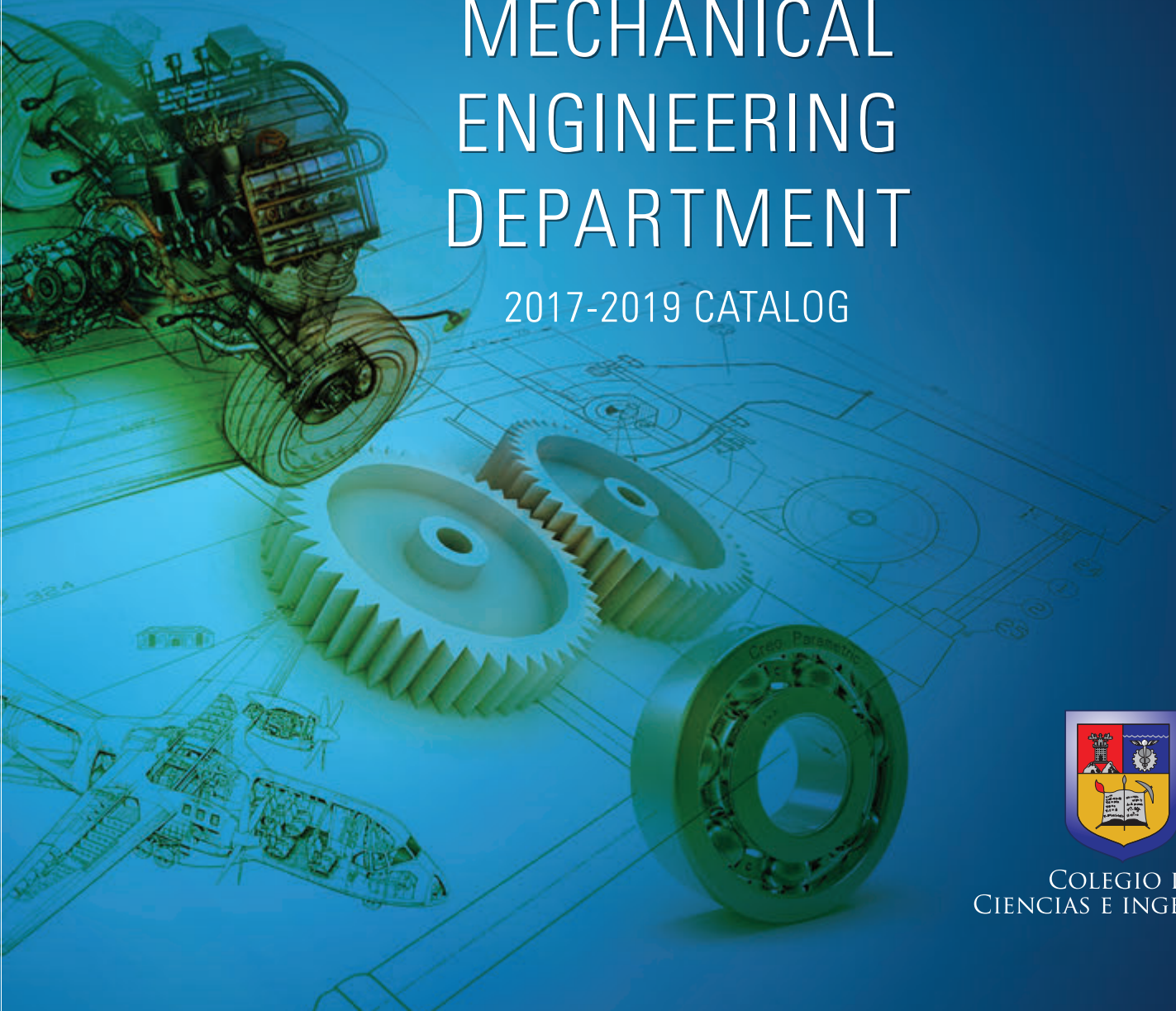
Universidad San Francisco de Quito

Science and Engineering College
"Colegio Politécnico"

MECHANICAL ENGINEERING DEPARTMENT

2017-2019 CATALOG



Colegio de Ciencias e Ingeniería

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Mechanical Engineering 2017-2019 Catalog

Introduction

The recent exponential growth of technology has changed the field of Mechanical Engineering (ME) and the ways we teach it. Inspired by this technological development, we aim to educate engineers with a strong background in math, sciences, and mechanical engineering who are flexible thinkers, bilingual and entrepreneurs. All these characteristics are validated by a wide range of experiences in industrial and academic-research activities. At USFQ, we educate engineers with a solid knowledge of Energy, Materials Processing, Mechanical Design, and Mechatronics.

In Mechanical Design we deal with Machine Design, Design for Manufacturability, Design of Energy Systems, Materials in Design, as well as the Industrial Automation and Robotics concepts. Of the same manner, the efficient use of energy and the generation of energy from renewable and non-renewable resources are vital for sustainable designs.

In addition, the new ME professionals can meet social needs, are aware of respecting the environment and are able to create conditions for social farewell, equality, and economic development. Supplementary ideas like the efficient use of materials and energy resources, protection of the environment and life, recycling, contaminants mitigation and control, occupational safety and health, alternative energy resources, bioengineering, engineering economics, contemporary issues, etc., are part of our mission.

Our Mission

To educate mechanical engineers that are leaders, entrepreneurs, creative professionals, humanists, and researchers; that display solid knowledge of the fundamentals, first principles, methods, practices, and specialized tools of mechanical engineering and related areas; and, that apply their skills towards sustainable production.

Prospective Mechanical Engineering Student

Individuals wishing to study Mechanical Engineering at USFQ should demonstrate analytical and critical thinking skills, be creative, have good oral and written communication skills, be able to apply logical-mathematical reasoning, and be Information Technologies (IT) savvy.

Additionally, candidates should have an academic background that allows them to pass the USFQ admission exam. Finally, a prospective student should be eager to learn in an environment characterized by freedom, reflection, and curiosity, and be motivated to find a balance between reason and emotion.

Graduate Profile

At USFQ we educate mechanical engineers capable of adopting new technologies and creating added value in their professional practice. Our graduates will be able to apply their knowledge to engineering and academic research endeavors, especially with regards to needs that arise from community or environmental concerns.

Fundamental capabilities

Our students will learn to calculate, design, build, and experiment in the areas of thermofluidics, mechanical systems, materials, and manufacture. These capabilities will allow them to identify, formulate, and propose solutions to engineering problems and day-to-day situations. Student will use modern engineering skills, techniques, and tools in the quest for solutions, using logical thought processes and applying scientific, technological, and engineering knowledge in order to develop products that solve problems of interest.

Professional capabilities

USFQ's mechanical engineers will be capable of implementing practical solutions to industrial and academic research problems. They will apply scientific and engineering fundamentals, and balance economic, environmental, social, and political factors, to successfully conclude engineering projects.

Social capabilities

Our Mechanical Engineering students will learn to appreciate contemporary issues so they can contribute to the advancement of industry and the wellbeing of society, acting in accordance to professional and ethical guidelines.

Educational capabilities

Our students develop discipline and capabilities for self-learning allowing them to continue their education during professional practice, graduate education, and life in general.

Leadership capabilities

Our students learn to effectively communicate their ideas and work within inter and multi-disciplinary teams.

Global awareness capabilities

Our Mechanical Engineering graduates will be capable of weighing the economic, environmental, and social impact of their engineering activities, taking into consideration a global context.

Program Educational Objectives (defined by ABET)

The faculty of the USFQ-Mechanical Engineering Department strives to continuously improve its undergraduate Mechanical Engineering Program. The educational objectives reflect identified needs, and have been reviewed by the relevant constituencies including: the Industry Advisory Board, the faculty, the students, and the alumni.

The Mechanical Engineering Department forms:

1. "Engineering Professionals" – graduates who will have solid knowledge of fundamental principles, methods, practices, and tools pertinent to Mechanical engineering and related fields, who will work in multidisciplinary networks with other engineers, and will demonstrate accountability and ethical and social responsibility.

2. "Leaders and Entrepreneurs" – graduates who will demonstrate leadership and entrepreneurial skills to develop and implement engineering solutions.

3. "Humanist" - graduates who will embrace the liberal arts philosophy to contribute to the scientific, technological, and sustainable development of their communities.

4. "Life-long learners"- graduates who will seek continuous improvement as engineers through professional development, graduate studies, training, and independent inquiry.

Student Outcomes

The Student Outcomes listed below are expected of all graduates of the Mechanical Engineering Program. ME graduates will have:

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

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

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

A brief description of the Graduate Profile

Development of the aforementioned capabilities starts with the study of basic subjects such as mathematics, physics, and engineering sciences. The next stage includes an initial approach to engineering processes (create, innovate, analyze, and evaluate), studying the subjects of design, energy, materials, system dynamics and control, and business and project management, as well as elective subjects that are of interest to each student. The following stage develops cultural awareness though courses in the humanities and social sciences. This modern, demanding, and solidly- structured curriculum enables our graduates to:

- Become competent engineers with practical skills in a wide range of activities.
- Practice engineering with enthusiasm, always aiming for personal and professional growth.
- Identify problems and determine strategies to solve them in a timely manner.
- Apply their knowledge in both industrial and academic research activities, always taking into account community and environmental needs.
- Become engineers who are leaders, entrepreneurs, creative, and humanistic, and that can adopt new technologies and create added value in their professional practice.

Experience and Professional opportunities

Being a student at USFQ affords unique opportunities, both locally and abroad. Solid knowledge foundations developed during the course of study allow USFQ graduates to rapidly adapt to new working environments, and to venture into new fields without hesitation or fear. This adaptability is an important advantage of our graduates, allowing them to succeed in the ever-changing professional world of today. Thanks to the exceptional humanistic and linguistic training gained during their college years, no matter what role our students are tasked with performing in the future, they will be effective negotiators, communicators, managers, and problem solvers.

In addition to being adaptable, our graduates receive valuable practical experience throughout their course of study. These experiences range from working with CNC machine tools, to working in the metals shop, to professional practices in various areas of mechanical engineering. There has been a consistently high demand for mechanical engineers in Ecuador these last few years. Thanks to their great capabilities, our graduates have been well received and endorsed in multiple fields of business, including the energy, oil production, petrochemical, manufacturing, metal construction, automotive, and metallurgic sectors, among others.

According to data gathered from our 2013 and 2014 graduates, 56% of them were employed by the first month after graduation. Our graduates either decide to continue their education (25%) or participate in the labor force (67%), where they work in the public sector (15%), the private sector (70%), or are self-employed (15%).

The contacts that USFQ professors and authorities have with representatives and professionals from multiple businesses and industries, both nationally and internationally, provide excellent job opportunities for our graduates.

Curricular requirements

The Mechanical Engineering Department offers four major areas of specialization: Design, Materials, Mechatronics, and Energy. These are not a graduation requirement: students may choose one if they desire a special mention.
The following General Curricular Requirements apply for all students admitted to the Mechanical Engineering Department. For a visual aid on the coursework required by Mechanical Engineering students, please see refer to the curricular flow diagram following this section.

Changes in this period

For the students enrolling after August 2017, the following major changes in the curriculum (with respect to the previous curriculum) are:

1. The course of "Thermodynamics and Introduction to Fluids" was eliminated
2. Two major experiences in design are mandatory, by the following modality:
   - Machine Design: the courses of Mechanical Design I and II are mandatory (Mechanical Design II includes a "Capstone Design Project" as an experience of machine design)
   - The technical selective/elective Design course: students must choose between the classes "Design in Manufacturability" or "Energy Systems Design". It is mandatory to take one of the two courses.
3. Students are required to take the "Industrial Automation" course as mandatory.
4. A new course, technical selective/elective is offered, students have 2 courses to choose from ("Reliability and Maintenance" or "QA/QC and Industrial Safety"). Students are required to take one of them (mandatory).
5. The old course of "Vibrations and Mechanism" was split into two, in the technical selective/elective courses: "Mechanical Vibrations" and "Mechanisms". Students are required to take one of them (mandatory).
6. Students are required to take 1 Chemistry class, "Applied Chemistry", which is a new revised course that combines and modifies the content from the 2 older courses.
7. Students are required to take a new course of "Design of Experiments".
8. Students are only required to take 1 Sports course (reduced from 2 courses).
9. Students are only required to take 1 Academic Writing course (reduced from 2 courses).
10. Students are only required to take 2 Elective courses from Liberal Arts (reduced from 4 courses).

Table 1. Mechanical Engineering Curricular requirements.

Section	Credit (C), Hours (H) or Times (T)	Brief Description
Basic Sciences Component	39 C	Common courses for all students in the College of Engineering prior to specialize as Mechanical Engineer: • Calculus 1 • Calculus 2 • Calculus 3 • Applied Chemistry • Biology for Engineering • Linear Algebra • General Physics 1 • General Physics 2 • Differential Equations • Statistics for Engineering • Numerical Analysis • Materials Science and Engineering • The Cosmos

Engineering Component	63 C	The courses required to specialize students as Mechanical Engineers include: • Fundamentals of Environmental Engineering • Basic Electronics • Thermodynamics I • Solid Mechanics • Dynamics • Design of Experiments • Fundamentals of Environmental • Computational Mechanics • System Dynamics • Heat Transfer • Mechanisms/ Vibrations (selective/elective) • Thermodynamics II • Materials Processing • Elective of Design • Fluid Mechanics • Mechanical Design I • Finite Element Method • Statics • Industrial Automation • Mechanical Design 2 (Capstone Design) • Senior Project 1 • Senior Project 2 Additionally, there are two types of Elective Engineering courses: (i) Three selective/elective courses: one in seventh semester, and one in eighth semester, and (ii) Four ME technical elective courses. The topics are described at the end of the document. The selective/elective for the seventh semester should be either "Mechanisms" or "Vibrations", grouped as "Elective Mechanisms/Vibrations" in the curriculum flow diagram. The elective courses for the eighth semester are "Elective of Design" and "Elective of Management". Noteworthy, when considering elective courses, the following information is important: • To fulfil the Elective of Management, the students may opt for either "Reliability and Maintenance" or "QA/QC and Industrial Safety". • To fulfil the Elective of Design Course, the students may opt for either "Design for Manufacturability" or "Energy Systems Design". • To fulfil the ME Technical Elective courses, the students can choose any of the available Elective Mechanisms/Vibrations and elective Design courses that have not been already taken in seventh and/or eighth semesters.
General Education Component	39 C	**Liberal Arts General College** Liberal Arts Courses required by USFQ (includes mandatory courses for every USFQ student): • Social Sciences 2000 (1 course) • Social Sciences 3000 (1 courses) • Arts (1 course) • Humanities (1 course) • Elective 1/2 • Elective 2/2 • Self- knowledge • Entrepreneurship • Writing and Rhetoric (English) • Academic Writing (Spanish) • The Self and the Cosmos • Introduction to Economics • Gastronomic Culture (0 credits course) • Programming 1 Almost every course offered by the University can be taken to fulfill elective course requirements. Certain courses from the areas of Arts, Social Sciences, Humanities, etc. are considered selective electives. electives from the area of Arts, Social Sciences, Humanities, etc.

	30 C	**ME General Education** ME General Courses required by USFQ. It includes courses mandatory for every ME Students: • Technical Drawing • Engineering Economics • Project Management • Machine Shop • Mechanical Drawing • ME Elective 1/4 • ME Elective 2/4 • ME Elective 3/4 • ME Elective 4/4 • Elective of Management As specified in the curriculum flow diagram, ME Technical Elective courses can be selected from a pool of 20+ courses. Senior Project I and Senior Project II are described in more detailed below.
Other Courses	0 C	These courses include Sports, Gastronomic Culture and English as a second language. These courses doesn't add credits to fulfill the total required for graduation. Students may validate English proficiency by taking an exam (dle@usfq.edu.ec).
Community-work internships	85 H	The community work internship (Learning and Service) is an educational method that combines both, educational objectives and community service to provide a pragmatic and progressive learning experience while fulfilling the needs of society. Thus, the students must take part in projects that serve the community located within or outside the city. The 85 hours required are fulfilled by taking the "learning and service seminar", 1.5 hours class per week; and working in the project the rest of the time (approximately, 5 hours per week). Students can register in this course starting from the second year.
Pre-professional Internships	240 H fulltime	Pre-professional internships offer students a hands-on opportunity to work in their chosen field. Internships allow students to apply knowledge gained during their studies in actual settings, providing them with valuable experience that increases their suitability as candidates when seeking employment after graduation. To obtain more information, be sure to visit the PASEM office at the start of the second to last year before graduation.
Attendance to Seminars/ Colloquiums	40 T	Students must participate in conferences or meetings pertaining to applied sciences. These meetings are organized by USFQ. A list of topics and dates of seminars is made available each semester. Please contact with Ms. Carolina Proaño, ceproano@usfq.edu.ec, for a copy of this document.
Course in English	Not Apply	Students must register for any one course taught in English. Course codes with a letter "E" at the end (e.g., ADM 1001E) indicate the subject is taught in English. Every subject taught in English has the ENG 1001E Writing and Rhetoric course as a pre-requisite. The ME Department may offer courses in English (i.e. Heat Transfer). Students can take this class to fulfill the Course in English requirement. They nevertheless have to fulfill the credit requirements stipulated under Liberal Arts General College.
Comprehensive Exam Preparation & Exam or Senior Project	6	Students are required by Ecuadorian law to finish their major with the presentation of a senior project or a comprehensive exam that covers knowledge from throughout the course of studies. Students in ME Department can choose to conduct a Senior Project during the last two semesters. This project can be the design of a machine or product prototype, a research study, a simulation, etc. The Senior Project is undertaken with the advice of a professor, who acts as a student advisor. More details can be found in the course description of this catalog. ME students can take a Comprehensive Exam instead of the Senior Project. This examination replaces the Senior Project courses. The Exam contains questions from topics including physics, math, and chemistry, though it mainly evaluates fundamental knowledge of mechanical engineering. An example of this test - the FE-Test for Mechanical Engineering- can be found in the following link: https://ncees.org/wp-content/uploads/2012/11/FE-Mec-CBT-specs.pdf. Students who take the option of Comprehensive Exam (six credits) must do so during the last semester of the major by enrolling in ten credits of Comprehensive Exam Preparation Course and ten credits of Comprehensive Exam.

SAN FRANCISCO DE QUITO UNIVERSITY
COLLEGE OF SCIENCE AND ENGINEERING
MECHANICAL ENGINEERING DEPARMENT
SINCE AUGUST 2017

FIRST YEAR

COD	FIRST SEMESTER	CREDITS
ARL 1001	Self-Knowledge	3
ARL 1002	Cosmos	3
ESP 1001	Academic Writing	3
MAT 1201	Calculus 1 (+Problems)	3
QUI 1001	Applied Chemistry (+Lab +Problems)	3
BIO 1103	Biology for Engineering (+Lab)	3
ESL 0001	English Level 1	0
	Total	18

COD	SECOND SEMESTER	CREDITS
ECN 1001	Introduction to Economics	3
ARL 2001	The Self and The Cosmos	3
LIT/FIL	Humanities	3
MAT 1401	Linear Algebra 1 (+Problems)	3
MAT 1202	Calculus 2 (+Problems)	3
ESL 0002	English Level 2	0
ESL 0003	English Level 3	0
	Total	15

SECOND YEAR

COD	THIRD SEMESTER	CREDITS
CCSS 2000	GC -Social Sciences 2000	3
FIS 2101	General Physics 1 (+Problems + Lab)	3
CMP 1101	Programming 1	3
MAT 2203	Calculus 3	3
MAT 2002	Differential Equations	3
IME 2001	Machine shop	3
ESL 0004	English Level 4	0
ESL 0005	English Level 5	0
	Total	18

COD	FOURTH SEMESTER	CREDITS
ELECTIVA	GC - Elective 1/2	3
ARTE	GC - Art	3
FIS 2102	General Physics 2 (+Problems+Lab)	3
INA 1001	Fundamentals of Environmental Engineering	3
MAT 3001	Numerical Analysis	3
ING 2001	Technical Drawing	3
ESL 0006	English Level 6	0
	Total	18

THIRD YEAR

COD	FIFTH SEMESTER	CREDITS
ENG 1001E	Writing and Rhetoric	3
ICV 2001	Statics	3
IEE 2001	Basic Electronics (+Lab)	3
IME 3001	Mechanical Drawing	3
IME 3101	Materials Science and Engineering (+Lab)	3
IME 3201	Thermodynamics 1 (+Problems)	3
ESL 0007	English Level 7	0
DEP XXXX	Sport	0
	Total	18

COD	SIXTH SEMESTER	CREDITS
MAT 2005	Statistics for Engineering	3
IME 3002	Dynamics (+Problems)	3
IME 3003	System Dynamics (+Lab)	3
IME 3004	Computational Mechanics	3
IME 3005	Solid Mechanics (+Lab+Problems)	3
IME 3202	Thermodynamics 2 (+Lab)	3
GST 0010	Gastronomic Culture	0
	Total	18

FOURTH YEAR

COD	SEVENTH SEMESTER	CREDITS
ADM 3002	Entrepreneurship	3
IIN 3005	Design of Experiments (+Lab)	3
IME OPT	Elective of Mechanisms/ Vibrations	3
IME 4001	Fluid Mechanics (+Problems+Lab)	3
IME 4002	Materials Processing (+Lab)	3
IME 4003	Heat Transfer (+Lab)	3
	Total	18

COD	EIGHTH SEMESTER	CREDITS
IME OPT	Elective of Design	3
IME OPT	Elective of Management	3
IME OPT	ME Elective 1/4	3
IME OPT	ME Elective 2/4	3
IME 4301	Mechanical Design 1	3
IME 4004	Finite Element Method (+Problems)	3
IME 4000	Preprofessional internship PASEM	0
	Total	18

FIFTH YEAR

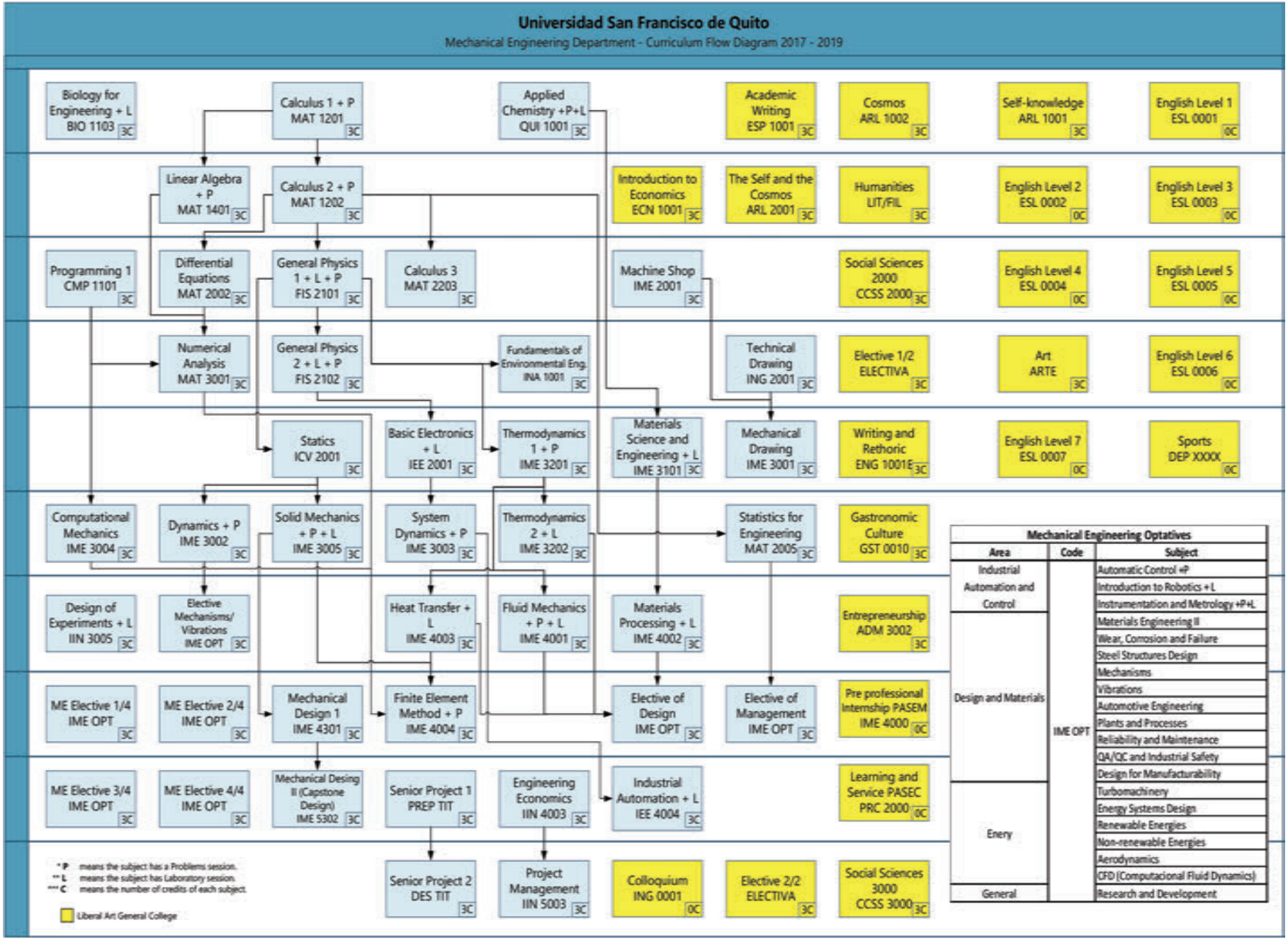
COD	NINTH SEMESTER	CREDITS
IEE 4004	Industrial Automation (+Lab)	3
IIN IIN 4003	Engineering Economics	3
IME OPT	ME Elective 3/4	3
IME OPT	ME Elective 4/4	3
IME 5302	Mechanical Design 2 (Capstone Design)	3
PREP TIT	Senior Project 1	3
PRC 2000	Learning and Service PASEC	0
	Total	18

COD	TENTH SEMESTER	CREDITS
CCSS 3000	GC - Social Sciences 3000	3
ELECTIVA	GC - Elective 2/2	3
IIN 5003	Project Management	3
DES TIT	Senior Project 2	3
ING 0001	Colloquium	0
	Total	12

TOTAL CREDITS 171

IMPORTANT CONSIDERATIONS

- Completing all necessary pre-requisites is mandatory before registering for a course.
- Students must comply with the sequence depicted in the flow diagram, in order to avoid complications while completing their studies.
- To fulfill the 2000 and 3000 Social Science requirement, students must choose a subject with one of the following codes: ANT (Anthropology)/ ARH (Art History) / HIS (History)/ RCL (Conflict Resolution)/ REL (International Relations) / POL (Political Sciences) / PSI (Psychology) / SOC (Sociology).
- To fulfill the Art requirement, students must choose a subject with one of the following codes: ART (Art) / DAN (Dance) / TEA (Theater) / MUS (Music).
- All English levels must be approved before registering for ENG 1001E Writing and Rhetoric.
- Any course that is not listed as mandatory in the curriculum can be taken as an elective for General College requirements.
- All courses in the College of Sciences and Engineering must be passed with a minimum grade of "C".



Notes:

- 3 Credits are equivalent to 144 hours.
- The course with 0 credits are degree requirements.
- To fulfil the Elective Mechanisms/Vibrations, the student can choose: Elective of Vibrations or Elective of Mechanisms.
- To fulfil the Elective of Design Course, the student can choose: Design for Manufacturability (Requisite: IME 4002), or Energy Systems Design (Requisite: IME 3202, IME 4001, IME 4003).
- To fulfil the Elective of Management, the student can choose: Reliability and Maintenance or QA/QC and Industrial Safety.

Courses and contents

Courses offered by the Mechanical Engineering Program give students knowledge and experience in the fundamentals of the field. Our courses emphasize engineering theory, and rely on project-based learning during labs and design activities. Graduates will develop solid quantitative skills, problem-solving capabilities, design abilities, and fluent communication skills. Detailed information on each course is provided in the "Course Descriptions" section below; details are from the latest available curriculum, and are subject to change.

Graduation requirements

To earn a Bachelor's Degree in Mechanical Engineering at USFQ, students must complete the following requirements:

- Fulfill the general graduation requirements for all students at USFQ. For more information, please refer to the Student Manual: http://www.usfq.edu.ec/sobre_la_usfq/informacion_institucional/politicasinstitucionales/Documents/manual_estudiante.pdf

- Accrue at least 171 credits, distributed as follows:
  - 69 credits corresponding to the General Education Component.
  - 39 Basic Sciences.
  - 57 credits corresponding to the Mechanical Engineering Component, passed with a minimum grade of "C".
  - 6 Credits corresponding to Senior Design Project I and II, passed with a minimum grade of "B".

- Complete at least 240 hours of pre-professional training or internship at a company, as approved by the University.

- Complete 85 hours of certified community work.

- Attend and pass at least 40 seminars related to engineering.

- Should a student decide not to take Senior Project I and II, he or she still has the option to take the E-Exam, which accounts for 6 Credits. The exam must be passed with a minimum grade of "C".

Minor in Mechanical Engineering

USFQ offers students from other departments the opportunity to obtain a minor in Mechanical Engineering. The requirements for a Mechanical Engineering Minor are:

- Pass at least 6 courses from among the following: ICV 2001-Statics, IME 3002-Dynamics, IME OPT- Mechanisms, IME OPT Vibrations, IME 3005-Solid Mechanics, IIN 0434 Design for Manufacturability, IME 4301-Mechanical Design 1, IME 3201-Termodynamics 1, IME 4001- Fluid Mechanics, IME 3001-Mechanical Drawing, IME OPT-Turbomachinery, IME OPT-Reliability and Maintenance, IME OPT-Introduction to Robotics.

- To opt for this minor, students must abide by all internal regulations of the Mechanical Engineering Department.

Aerospace Engineering at Embry Ridley University

Engineering students at USFQ have the opportunity to start an Aerospace Engineering major in Ecuador and finish that undergraduate program at the prestigious Embry Ridley University (ERAU) in the USA. Ranked as the top university to study aerospace engineering in the USA, ERAU is located in Daytona Beach, Florida (http://www.erau.edu/).
The course of study for students interested in Aerospace Engineering is as follows:

- Study at USFQ for three years, sharing classes with Mechanical Engineering peers.

- Study at ERAU for three semesters and a summer, as stipulated by the agreement between the two institutions.

- After completion of all the requirements for graduation, students will receive a Bachelor's degree in Aerospace Engineering from ERAU.

- In addition to Aerospace Engineering at ERAU, students can choose either Astronautics or Propulsion Engineering. In this case, their studies will take four semesters instead of three. More info here: • http://catalog.erau.edu/daytona-beach/engineering/bachelors/aerospace-engineering/

- To study at ERAU, estimated tuition, fees, and living costs per year are 46,200 USD, which a student must cover. USFQ is not responsible for any or all of these expenses as the student leaves USFQ to transfer to ERAU. More information on costs here: http://daytonabeach.erau.edu/admissions/estimated-costs/index.html

- Students that transferred from other institutions to USFQ can only carry their USFQ credits when transferring to an ERAU engineering program.

- The USFQ does not offer an Aerospace Engineering degree in Ecuador. The USFQ only allows students interested in this major to start their course of study as Mechanical Engineering students at USFQ and facilitates their transfer of credits to ERAU.

For inquiries and more information, contact Gisela Sanchez (Academic Assistant at the USFQ College of Science and Engineering): gsanchez@usfq.edu.ec; or, Alfredo Valarezo (Mechanical Engineering Program Coordinator): avalarezo@usfq.edu.ec.

Change of Academic Program

For general information on how to change your academic program, please refer to the Student Manual: http://www.usfq.edu.ec/sobre_la_usfq/informacion_institucional/politicasinstitucionales/Documents/manual_estudiante.pdf

Facilities

The Mechanical Engineering Department is equipped with classrooms for effective delivery of lectures, as well as state of the art shops, laboratories, and research facilities. This infrastructure helps complement theoretical knowledge imparted in the classroom with practical activities and experiments covering the principal areas of mechanical engineering: energy, manufacturing, mechatronics, and materials. The Mechanical Engineering laboratories, facilities, and shops available at USFQ are described in Table 2.

Mechanical Engineering Facilities

Table 2. Mechanical Engineering Department Facilities information

Name	Type	Room code (Building)	Professor in charge	Major pieces of equipment	Classes supported by this lab
Energy and Thermodynamics Lab.	Lab	M-001-B (Maxwell)	David Escudero / Luis Castellanos	Heat pump, air conditioner and refrigeration unit, vapor turbine with vapor generator unit, gas axial turbine.	Technical Drawing, Mechanical Drawing, Plants Desing.
Microscopy Lab.	Lab	M-001-E (Maxwell)	Michel Vargas	Scanning electron microscope, SEM (Jeol, IT-300).	Machine Shop I (Metal Machining).
Materials Engineering Lab.	Lab	M-001-C/D (Maxwell)	Marco León/ Lorena Bejarano	Light Inverted microscope, muffle furnace, polishing machine, fume hood, precision cutter, metallographic compression mounting press, vacuum mounting pump, ultrasonic cleaner.	Machine Shop II (Welding).
Robotics & CAD/CAM	Lab	M-001-A (Maxwell)	Michel Vargas/ Carlos Andrade	CNC milling machine, CNC lathe, robotic arm (pick and place), industrial process simulation unit, double storage tank compressor.	Solid Mechanics; Materials Processing I; Materials Processing II.
Plant Design Lab-Santos CMI	Lab	M-327 (Maxwell)	Juan Sebastián Proaño	High Performance Computers.	Engineering Materials; Materials Processing I; Materials Processing II; Manufacturing Engineering; Wear, Corrosion, and Failure.
Machine Shop	Shop	HS-400-H (Hayek)	Fabián Morales	CN lathe, CN milling machine, manual lathe, manual milling machine, electric hacksaw machine, pillar drill, surface grinder, electric emery.	Research-only laboratory
Welding and Casting Lab	Shop	HS-400-K (Hayek)	Fabián Morales	Welding machinery (6 for SMAW, 1 for MIG, 1 for TIG), spot welding machine, oxy-acetylene welding equipment, hydraulic press, compressor, muffle-type furnace.	Fluid mechanics; Heat transfer.
Mechanical Testing Lab.	Lab	HS-400-G (Hayek)	Alfredo Valarezo / Westly Castro	Universal mechanical testing machine (Tinius Olsen, 300 kN), flexural testing (100 kN), concrete compression tester.	Fluid mechanics.
Non destructive testing and Metrology Lab.	Lab	HS-400-I (Hayek)	Alfredo Valarezo / Westly Castro	Penetrant and magnetic powder applicators, magnetic particle detector, UV back light bulb, hardness tester for Vickers, Brinell, and Rockwell; 3D-printers.	-
Innovation and Advanced Manufacturing	Lab	HS-400-J (Hayek)	Alfredo Valarezo	Flame spray gun, 6-axys robot KUKA, powder spray torch, ICP-curvature system, exhaust systems, hydraulic crane.	

Transport phenomena	Lab	N-101 (Newton)	Daniela Almeida /Luis Castellanos	Tabletop demonstration units for convective and radiative heat transfer, heat exchangers.	
Fluid mechanics	Lab	N-101 (Newton)	Daniela Almeida /Luis Castellanos	Demonstration units for flow measurement, flow visualization (Reynolds-Osborne apparatus), major and minor friction losses in pipes, flow over weirs.	
Autonomous Vehicles	Lab	M-324 (Maxwell)	Carlos Andrade	Submarine; UGV (unmanned ground vehicle); quadcopter.	

Use of Laboratory Facilities

Allowed personnel

The use of ME Department Laboratories is limited to individuals in one or more of the following categories:

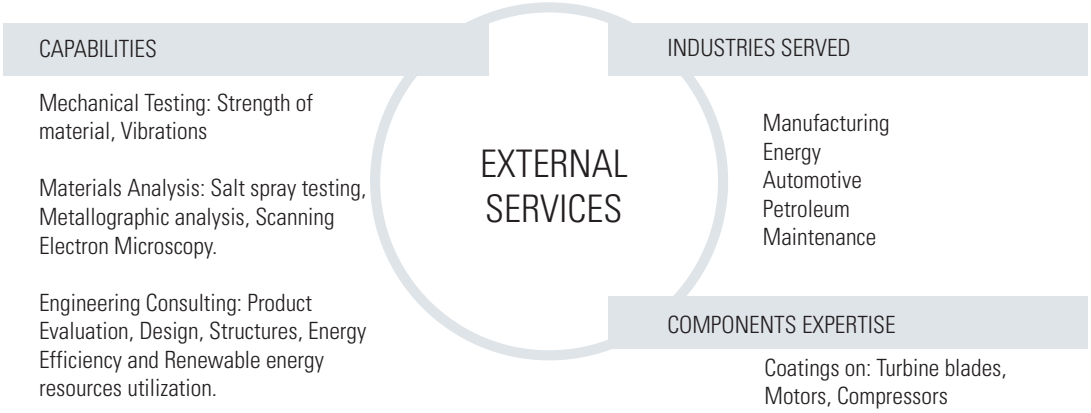
- Members and instructors of the ME Department, including undergraduate teaching assistants, using laboratories to carry out their teaching, research, or service obligations.
- Students currently enrolled in courses at the ME Department who are using laboratories to carry out work that is part of a course in which they are currently enrolled, under supervision of the Laboratory Coordinator or the Laboratory assistant.
- Undergraduate students at the ME Department who have received written authorization to carry out university-related work from the ME Department Chair, who is assigned responsibility for such authorizations.
- Any other person who has received proper authorization to use a laboratory from the ME Department chair or the Laboratory Coordinator.

General policies of use

- Always review the safety procedures of the laboratory in use.
- Abstain from smoking, eating, littering, and drinking in all the laboratories.
- Use all laboratory equipment properly, in accordance to the relevant Standard Operating Procedure (SOP) documents. Do not sit on tables and do not open cabinets or lockers unless authorized to do so by the Laboratory Coordinator.
- Turn off all electrical equipment in the laboratory when not in use.
- The last person to leave the laboratory must turn off the lights, fans, air conditioners, and computers, lock the doors, and close the windows.
- Use only the equipment required for purposes related to experiments being performed.
- Maintain the cleanliness of the laboratory at all times.
- Students are not allowed to stay inside the laboratories beyond their class hours, unless they have respective authorization and supervision.
- Any person who believes that one or more persons are using any laboratory without appropriate authorization should report the matter to the ME Department Chair or Laboratory Coordinator.
- Should you require any further information or help, please refer to the respective Laboratory Coordinator.

External Service

The Mechanical Engineering Department is able to provide engineering services through their facilities and staff. The department can deliver advanced technology solutions, innovative thinking, and breakthrough research to improve productivity and efficiency for industrial applications in Ecuador and South America. Our highly-skilled staff have extensive experience in mechanical design, materials science and engineering, and energy utilization.



Faculty

The members of the Mechanical Engineering Department have expertise in multiple fields of engineering and sciences, allowing students to learn and collaborate in a rich and diverse academic environment.

Table 3. Mechanical Engineering Faculty

Name	Office (room code)	Extension	Main Area of Interest	Recent education
Lorena Bejarano	BS215	1047	Materials characterization and coatings	Doctor of Philosophy – Materials Science and Engineering, Stony Brook University, 2016.
Edison Bonifaz	M308	1235	Computational Mechanics	Doctor of Philosophy – Materials Engineering, Universidad de Navarra, 2001.
Patricio Chiriboga	H323	1219	Acoustics	Doctor of Philosophy – Mechanical Engineering, Delft University of Technology, 2013.
David Escudero	H323	1218	Energy	Doctor of Philosophy – Mechanical Engineering, Iowa State University, 2014.
Marco León	M308	2031	Materials	Master of Science – Mechanical Engineering, Materials,Corrosion, RWTH-Aachen, Germany, 2016.
Juan Sebastián Proaño	M308	2030	Energy	Doctor of Philosophy – Mechanical Engineering and Biorenewables, Iowa State University, 2017.
Alfredo Valarezo	HS-400W	1048	Surface Engineering and Coatings	Doctor of Philosophy – Materials Science and Engineering, Stony Brook University, 2008.
Michel Vargas	M105-B	1061	Materials Characterization	Doctor of Philosophy – Materials Science and Engineering, Virginia Tech, 2015.
Carlos Andrade	M324	1211	Automation	Electronic Engineer – Universidad San Francisco de Quito, 2015.
Westly Castro	HS400 C	1244	Solid Mechanics	Mechanical Engineer – Universidad San Francisco de Quito, 2015.
Luis Castellanos	M324	2069	Energy/Simulation Projects	Master MDI– Universidad San Francisco de Quito, 2017

Faculty Council

All faculty members participate in the Mechanical Engineering Council, which, among others, is responsible for deciding on changes to the academic program, new undergraduate and graduate programs, budget planning and execution, and strategic planning. The council takes decisions on student requests that are not contemplated in any other manual. The Council meets regularly once a month. The Council can generate regulations for the ME Department.

Research and Projects

The Mechanical Engineering Department is part of the College of Science and Engineering, called the Colegio Politécnico at USFQ. The College has established certain principal research subjects in order to facilitate collaboration among faculty members and further institutional objectives. The principal research subjects were established in light of community and environmental needs, as well as taking into account faculty potentials and interests. The research subjects and interests of the Mechanical Engineering Department are summarized in Table 4.

Collaboration with Industries and Academia

The Mechanical Engineering department has established connections with multiple national and international institutions in order to undertake projects, provide students with internships, and provide professional services. Select examples of institutions with whom USFQ has worked in the past include:

- Ecuador: Repsol, Santos CMI, Minga-Servicios Petroleros, Imetca, Greepo Energy, Aktive, etc.

Table 4. Mechanical Engineering Research Areas and their connection with the main research subjects.

"Colegio Politécnico" Research Subjects	Mechanical Engineering Research areas
Properties and applications of materials	Materials characterization for multiple applications.
	(i.e. micro-fractures in concrete, contaminants removal with bio-adsorbents, Scaffolds)
	Components remanufacturing using thermal spray, welding, Additive Manufacturing, Plasma/Arc spraying, HVOF, Multiscale Modelling, Polycristal Plasticity.
	Materials performance in body implants and medical-grade equipment.
Alternative Energy sources	Energy efficiency in gas turbines, electric vehicles, and cooking systems.
	Experimental and computational studies of multiphase flows.
	Production of energy and chemicals from residual biomass.
Environment and Pollution remediation	Biochar application for agricultural soils remediation.
	Use of biochar as filtering media for pollutant removal.
Mobile networks	Data transfer and real-time processing applications for Unmanned Aerial Vehicles (UAVs).
Particle physics	N/A
Cosmology	N/A

- International: Oak Ridge National Lab (ORNL), TN, USA; Center for Thermal Spray Research (CTSR), NY, USA; Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional (CINVESTAV), Querétaro, Mexico; VTT, Finland; European Organization for Nuclear Research (CERN), etc.

- The Mechanical Engineering department has established connections with multiple national and international institutions in order to undertake projects, provide students with internships, and provide professional services. Select examples of institutions with whom USFQ has worked in the past include:

Ongoing Projects

Ongoing research projects carried out by the Department of Mechanical Engineering include:

- Effect of arsenic on pre-hispanic bells. HUBi code: 10097. Leader: Patricio Chiriboga. Year: 2018.

- On the Elastic-Inelastic-Plastic of the Thermal Spray Coatings under Thermal Loading. HUBi code: 5498. Leader: Lorena Bejarano. Year: 2017.

- Remanufacturing of costly spare parts and evaluation of its impact on sustainable development. HUBi code: 5499. Leader: Alfredo Valarezo. Year: 2017.

- Unmanned Aerial Vehicles (UAVs) for monitoring marine life diversity. HUBi code: 5480. Leader: Alfredo Valarezo. Year: 2017.

- Thermal projection solidification using magnetism. HUBi code: 5489. Leader: Alfredo Valarezo. Year: 2017.

- Experimental and Computational Multiphase flow studies. HUBi code: 5496. Leader: David Escudero. Year: 2017.

- Prediction of Microstructure Evolution in Powder Bed AM (Additive Manufacturing) Processing of Ni/alloys during Single Laser Passes: Computational Engineering Group. Id HUBi code: 5500. Leader: Edison Bonifaz. Year: 2017.

- Finite Element Modeling of Materials Processing (Laser Welding, Friction Stir Welding, GMAW, Functionally Graded Thermal Barrier Coatings, Repair of Gas Turbine Components). Leader: Prof. Edison Bonifaz.

- Finite Element Modelling of Directed Energy Deposition Processes: An integrated model to simulate the evolution of residual stresses, plastic strains and dislocations. Leader: Prof. Edison Bonifaz.

- Thermo-mechanical Modelling of Advanced High Temperature Materials for Power Generation. Development of user material (UMAT, DFLUX, DLOAD, FILM, HETVAL, etc.) subroutines in ABAQUS® to analyze thermo-mechanical deformation and associated continuum damage mechanics. Leader: Prof. Edison Bonifaz.

- Cohesive zone models based on the micromechanics of dislocations (A unified treatment of fatigue crack initiation, fatigue crack growth, and stable tearing crack growth). Leader: Prof. Edison Bonifaz.

- Polycrystalline Plasticity (Elastic-plastic models, viscoplastic models, strain gradient models) using the ABAQUS-DREAM 3D coupling. Leader: Prof. Edison Bonifaz.

- Multi-Phase Steels Modeling (Multiscale modeling, material constitutive theories, dislocation theories, modeling of

materials with non-linear characteristics). Leader: Prof. Edison Bonifaz.

A list of the most recent publications is presented in the "Recent Academic Publications" section at the end of this catalog.

Mechanical Engineering Fair

The ME Department has implemented Project-Based Learning (PBL) methodologies. Every semester, the Mechanical Engineering Department organizes an Engineering Fair that offers students an opportunity to present and demonstrate their course projects, and capstone or senior design projects. More than a hundred projects related to the areas of energy, design, inverse engineering, vibrations, structures, among others, are displayed. The Mechanical Engineering Fair is open to the campus community, nearby high and middle school students, industry representatives, and anyone interested in engineering and technology.

At the end each fair, Mechanical Engineering staff and special guests select the best projects. Winning projects receive either a cash prize or a certificate of recognition by the Mechanical Engineering Department.

In addition to the projects on display, junior engineering students design and construct models for multiple competitions, including the robot follower, tower crane, and trebuchet catapult contests, and the Computer Aided Design (CAD) Challenge.

Student Groups and useful links

American Society of Mechanical Engineers (ASME)

The ASME student chapter at Universidad San Francisco de Quito (USFQ) consists of approximately 50 members.

Mission: Incentivize members to get involved in the fields of design, energy, and materials during their course of study. This is achieved by carrying out extracurricular activities such as competitions, courses, and training sessions.

The main events of ASME USFQ correspond to the following:

- CAD Challenge.
- CAD / CAM course in agreement with BKB Company.

In general, two CAD/CAM courses are offered per semester, one at the beginning and one at the end. In addition, prizes are awarded to the winning projects of the Tower Crane Contest, Catapult Contest and CAD Challenge competitions held during the USFQ Engineering Fair.

The ASME-USFQ's office is currently located in Basement 4 of Hayek building.

Opening hours: We are available Monday - Thursday since 10:00 until 11:20 and on Fridays by previous appointment.

Material Advantage

The Material Advantage chapter at Universidad of San Francisco de Quito (USFQ) is tasked with creating a bond between students and materials science and engineering in order to strengthen this mechanical engineering niche in Ecuador. It is the only chapter accepted by the organization in the entire country.

The main annual events for the Materials Advantage Chapter is:

- Materials Annual Conference: presenting all around the world and national panelist.
- Metallography Challenge: A contest to determine the best quality images.

In addition to the Annual Conference, current plans contemplate organization of lectures on the diversity of fields covered by Material Advantage, as well as establishing relevant internships for members.

Membership has a cost of 31.50 USD, with taxes, and includes additional affiliation to ACerS (American Ceramic Society), AIST (Association for Iron & Steel Technology), ASM (Materials Information Society), and TMS (Minerals, Metals and Materials Society).

We are located in the fourth underground floor of the Hayek Building. Office hours: Monday and Wednesday, 13:00-16:00; Tuesday and Thursday, 10:30-14:00; and, Friday and weekends, by previous appointment.

Students Clubs

There are multiple social clubs on campus that pursue a variety of interests. For more information, visit: http://www.usfq.edu.ec/estudiantes/clubs_campus_life/Paginas/default.aspx

Government of the Students Body (GOBE)

GOBE is the connection between students and the University administration. It provides assistance with various student procedures and required paperwork. For more information, visit: http://www.usfq.edu.ec/estudiantes/gobe/Paginas/gobe.aspx

Useful links

General services for students: http://www.usfq.edu.ec/sobre_la_usfq/servicios/Paginas/default.aspx
Learning Center and Tutoring: http://www.usfq.edu.ec/estudiantes/learning_center/Paginas/learning_center.aspx
Career services (Internships, Career fair, etc.): http://www.usfq.edu.ec/estudiantes/contacto_empresarial/estudiantes/servicios/Paginas/servicios.aspx

Course Descriptions (Grouped by semesters)

1st SEMESTER

MAT 1201-Calculus 1 + Problems (3 Credits)

Class code: MAT 1201
Pre-Requisite: None
Co-Requisite: Problems in Calculus I
Description: This course covers basic topics of differential calculus as applied to engineering and sciences. Students learn how to accurately measure rate of change and movement, calculate exact amounts, and optimize magnitudes. The course is aimed at students majoring in engineering.

QUI 1001-Applied Chemistry + Problems+ Lab (3 Credits)

Class code: QUI 1001
Pre-Requisite: None
Co-Requisite: Problems and Lab in Applied Chemistry
Description: This course covers basic topics of chemistry including stoichiometric calculations, solutions, kinetics, gases, chemical equilibrium, basic thermodynamics, and thermochemistry principles.

BI0 1103-Biology for Engineering (3 Credits)

Class code: BI0 1103
Pre-Requisite: N/A
Co-Requisite: N/A
Description: This course covers the fundamental principles of biology. It is aimed at students majoring in sciences and engineering. The course introduces a modern vision of biology, its boundaries, challenges, and technological possibilities.

General College Courses:

- Self-knowledge. Class code: ARL 1001 (3 Credits)
- Academic Writing (Spanish). Class code: ESP 1001 (3 Credits)
- Cosmos. Class code: ARL 1002 (3 Credits)
- English Level 1: ESL 0001 (0 Credits)

2nd SEMESTER

ECN 1001-Introduction to Economics (3 Credits)

Class code: ECN 1001
Pre-Requisite: None
Co-Requisite: None
Description:
The course is focused on teaching students of any major the basic knowledge about economic science. This class has two objectives: 1) to study decision-making tools for businesses and 2) to study the national and international macroeconomic reality.

MAT 1401-Linear Algebra 1 + Problems (3 Credits)

Class code: MAT 1401
Pre-Requisite: MAT 1201 Calculus 1
Co-Requisite: Problems in Linear Algebra
Description: Linear Algebra is an area of mathematics devoted to the study of linear operators on vector spaces. Linear algebra is a corner-stone of any engineering where the spaces and operations are studied and become a commonplace in many different areas of mathematics, science and engineering. This course covers the basic and fundamental topics of linear Algebra, including: vector space, linear transformations, eigenvalues and eigenvectors, among others.

MAT 1202-Calculus 2 + Problems (3 Credits)

Class code: MAT 1202
Pre-Requisite: MAT-1201 Calculus 1
Co-Requisite: Problems in Calculus 2
Description: This course covers basic topics of integral calculus as applied to engineering. Topics covered include running sums, calculation of exact amounts, calculation of areas and volumes of irregular bodies, and infinite sums.

General College Courses:

- The Self and The Cosmos. Class code: ARL 2001. (3 Credits)
- Humanities. Class code: LIT/FIL. (3 Credits)
- English level 2. Class code: ESL 0002 (0Credit)
- English level 3. Class code: ESL 0003 (0 Credit)

3th SEMESTER

FIS 2101-General Physics 1 + Problems +Lab (3 Credits)

Class code: FIS 2101
Pre-Requisite: MAT 1201 Calculus 1
MAT 1202 Calculus 2
Co-Requisite: Lab General Physics 1
Problems in General Physics 1
Description: General Physics 1 is the first of a two semester sequence course that is usually taken by engineering students. The course is an introduction to physics, both classical and modern. It is based on calculus. The goal of the course is to study of fundamental knowledge of physics and learn important skills that will be useful in engineering application. Topics of the course includes mechanics, oscillations and thermodynamics, among others.

CMP 1101-Programming 1 (3 Credits)

Class code: CMP 1101
Pre-Requisite: None
Co-Requisite: None
Description: This course teaches fundamental concepts and terminology of computer programming. Students will develop skills necessary to design and write simple computer programs. The code to be taught is C language, which is widely used in engineering colleges around the world. The course includes an introduction to object-oriented programming. No programming background is required.

MAT 2203-Calculus 3 (3 Credits)

Class code: MAT 2203
Pre-Requisite: MAT 1201 Calculus 1
MAT 1202 Calculus 2
Co-Requisite: None
Description: Calculus 3 is the third of a three semester sequence course. The course is designed to develop the topics of multivariate calculus. Emphasis is placed on multivariate functions, partial derivatives, multiple integration, vector valued functions, and line and surface integrals, among others. Upon completion, students should be able to select and use appropriate models and techniques for finding the solution to multivariate-related problems.

MAT 2002-Differential Equations (3 Credits)

Class code: MAT 2002
Pre-Requisite: MAT 1202 Calculus 2
Co-Requisite: None
Description: This course presents the basic and fundamental concepts of ordinary differential equations (ODEs) and partial differential equations (PDEs). This course covers first and higher order linear differential equations, the Laplace transform, systems of differential equations, ODE applications, orthogonal functions, and Fourier series. The heat, wave, and Laplace equations are part of the applications in this course.

IME 2001-Machine Shop (3 Credits)

Class code: IME 2001
Pre-Requisite: None
Co-Requisite: None
Description: This course covers two important parts. The first one is focused on developing reasoning and analytical skills to use machine tools for constructing parts of different mechanisms. In the second part, the fundamental concepts of welding technology and its importance in industry are studied. Emphasis is placed on basic processes and safety practices. By successfully completing this course, a student should be able to operate basic machine and welding equipment.

General College Courses:

- Social Science 2000. Class code: CCSS 2000 (3 Credits)
- English level 4. Class code: ESL 0004 (0 Credits)
- English level 5. Class code: ESL 0005 (0 Credits)

4th SEMESTER

FIS 2102-General Physics 2 + Problems +Lab (3 Credits)

Class code: FIS 2102
Pre-Requisite: MAT 1202 Calculus 2
FIS 2101 General Physics 1
Co-Requisite: Lab General Physics 2
Problems in General Physics 2
Description: Professional engineers require a clear understanding of the physical models that explain electric and magnetic fields. In this course students will review each field separately in qualitative detail. Then electric and magnetic fields will be studied together as constituents of the electromagnetic field. These fields describe all electromagnetic phenomena, constituting the physical basis of modern technology.

INA 1001-Fundamentals of Environmental Engineering (3 Credits)

Class code: INA 1001
Pre-Requisite: QUI 1001 Applied Chemistry
FIS 2101 General Physics 1
Co-Requisite: None
Description: This course is designed to teach the basic aspects of mass balance and its application in environmental management.

MAT 3001-Numerical Analysis (3 Credits)

Class code: MAT 3001
Pre-Requisite: MAT 2002 Differential Equations
MAT 1202 Calculus 2
MAT 1401 Linear Algebra
Co-Requisite: None
Description: Most engineers are sooner or later faced with computing tasks that require some knowledge of numerical analysis. The principal goal to the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems on the computer. Students will examine the mathematical foundations of well-established numerical techniques and explore their usage through practical examples.

ING 2001-Technical Drawing (3 Credits)

Class code: ING 2001
Pre-Requisite: None
Co-Requisite: None
Description: In this course, students will learn standard representation and drafting techniques, as well as rules and regulations concerning to technical drawing. It will provide a strong theoretical base in combination with examples and exercises. In addition, students will learn how to use a computer aided drawing software (AutoCAD). At the end of this class the student will be able to recognize, compose, and interpret drawings in various fields of Engineering.

General College Courses:

- GC – Elective 1/2. Class code: ELECTIVA (3 Credits)
- GC - Arts. Class code: ARTE (3 Credits)
- English level 6: Class code: ESL 0006 (0 Credits)

5th SEMESTER

ICV 2001-Statics (3 Credits)

Class code: ICV 2001
Pre-Requisite: FIS 2101 General physics 1
Co-Requisite: None
Description: This is the first in a series of courses aimed at understanding the mechanical behavior of structures, mechanisms, and machine components. This course deals with analysis of force and moment systems for static equilibrium of trusses, beams, frames, and machines; elements of frictions; centroid, center of gravity, center of mass, and moment of inertia. The course will be presented using formats that include lectures, discussions and problems.

IEE 2001-Basic Electronics + lab (3 Credits)

Class code: IEE 2001
Pre-Requisite: FIS 2102 General Physics 2
Co-Requisite: Lab Basic Electronic
Description: This course teaches students of science and engineering the fundamental and basic skills necessary for using electrical signals, as well as their integration into electronic monitoring and control systems.

IME 3001-Mechanical Drawing (3 Credits)

Class code: IME 3001
Pre-Requisite: ING 2001 Technical Drawing
Co-Requisite: None
Description: In this course students will learn the correct representation of drawing documents which involve detailed engineering on mechanical components, parts, and full assemblies. The students can virtually build components and assemble them together using a mechanical design software

(Autodesk Inventor). By the end of the course it is expected that the students would be able to visualize any engineering component by drawing or reading a drawing.

IME 3101-Materials Science and Engineering + Lab (3 Credits)

Class code: IME 3101
Pre-Requisite: QUI 1001 Applied Chemistry
Co-Requisite: Material Science Lab
Description: In this course students will learn basic principles that govern the properties and behavior of engineering materials; atomic structures, interatomic forces, amorphous and crystalline structures; phase transformations; the study of the capabilities and limitations of different materials: metals, polymers, ceramics; and performance aspects of fracture, corrosion, etc. At the end of this class the student will be able to select materials for multiple applications.

IME 3201-Thermodynamics 1 + Problems (3 Credits)

Class code: IME 3201
Pre-Requisite: FIS 2101 General physics 1
Co-Requisite: Thermodynamics 1 Problems
Description: Thermodynamics 1 is the first of a two semester sequence course. In this course the fundamentals of Thermodynamics are studied with emphasis on the processes of energy transformation. The course deals with the fundamental principles of heat and work, the laws of thermodynamics, thermodynamic processes, phase changes, thermodynamic cycles, among others. Students will use also software to look for substance properties and solve system equations.

General College Courses:

- Writing and Rhetoric (English). Class code: ENG 1001E. (3 Credits)
- Sports. Class code: DEP XXXX. (0 Credits)
- English level 7. Class code: ESL 0007 (0 Credits)

6th SEMESTER

IME 2005-Statistics for Engineering +Problems (3 Credits)

Class code: IME 2005
Pre-Requisite: MAT 1202 Calculus 2
Co-Requisite: Problems in Statistics for Engineers
Description: This course introduces the principles of statistics and applies statistical tools towards problem solving, data evaluation, and decision-making. The course is essential to further study in higher level engineering courses.

IME 3002-Dynamics + Problems (3 Credits)

Class code: IME 3002
Pre-Requisite: ICV 2001 Statics
Co-Requisite: Problems in Dynamics
Description: The course presents basic concepts required to analyze the motion of dynamic systems. It covers the analysis of particle and rigid body motion of using different coordinate systems.

IME 3003- Systems Dynamics +lab (3 Credits)

Class code: IME 3003
Pre-Requisite: IEE 2001 Basic Electronic
Co-Requisite: Dynamic of Systems Lab
Description: In this course the dynamics of engineering systems is studied. This is a discipline focused on deriving and solving mathematical models that represent simplified versions of actual systems, such as mechanical, electrical, fluid, or thermal. In the assignments and the projects, the system dynamics framework will be applied to solve problems. Additionally, the course includes the use of software and the elaboration of laboratory experiments.

IME 3004-Computational Mechanics (3 Credits)

Class code: IME 3004
Pre-Requisite: MAT 3001 Numerical Analysis
CMP 1101 Programming 1
Co-Requisite: None
Description: T Introduction to computational heat transfer and computational kinematics. Class aimed at junior-year students with a solid background in differential and integral calculus, and numerical analysis. Main sections: (i) Use of the Finite Difference Method to solve complex parabolic partial differential equations, (ii) use of applied programming concepts to solve dynamic systems. Methodology: Problem Based Learning (PBL).

IME 3005-Solid Mechanics + Problems + Lab (3 Credits)

Class code: IME 3005
Pre-Requisite: ICV 2001 Statics
Co-Requisite: Solid Mechanics Lab
Problems in Mechanics of Solids
Description: Use of fundamental concepts of solid mechanics. Design of metallic structures, machine elements, and mobile systems. The students analyze and calculate stresses and strains in different loading scenarios. Mechanical engineering students will learn dimensioning and materials selection for machine elements design. For civil engineers, the class content will allow them to design structural components and basic structures.

IME 3202-Thermodynamics 2 + Lab (3 Credits)

Class code: IME 3202
Pre-Requisite: IME 3201 Thermodynamics 1
Co-Requisite: Thermodynamics 2 Lab
Description: This course covers the fundamental principles of thermodynamic cycles and processes used in power generation, heating, and cooling. Course contents include the Carnot, Otto, Diesel, Stirling, Ericsson, Brayton, and Rankine cycles, as well as heating and cooling systems, air conditioning, etc..

General College Courses:

- Gastronomic Culture. Class code: GST 0010 (0 Credits)

7th SEMESTER

IME OPT - Elective of Vibrations (3 Credits)

Class code: IME OPT
Pre-Requisite: IME 3002 Dynamics
Co-Requisite: None
Description: This course introduces the analysis of mechanical vibrations. Course contents include prediction of free and forced vibration behavior with single and multiple degrees of freedom, as well as in continuous systems.

IME OPT - Elective of Mechanisms (3 Credits)

Class code: IME OPT
Pre-Requisite: IME 3002 Dynamics

Co-Requisite: None
Description: This course introduces students to the analysis of mechanisms using principles of dynamics. Students learn about different mechanisms; kinematics and kinetics of the rotor; design of cam and follower systems; static and dynamic balance; and, robot mechanics.

IME 4001-Fluid Mechanics + Problems + Lab (3 Credits)
Class code: IME 4001
Pre-Requisite: IME 3201 Thermodynamics 1
Co-Requisite: Fluid Mechanics Lab
Problems in Fluid Mechanics
Description: This course covers basic concepts of fluid mechanics; the motion of particles and rigid bodies when interacting with a fluid; and, calculation of friction losses in pipe systems as well as the power required to overcome them. The class also provides an introduction to aerodynamics and turbomachinery.

IME 4002-Materials Processing + Lab (3 Credits)
Class code: IME 4002
Pre-Requisite: IME 3101 Engineering Materials
Co-Requisite: Material Processing Lab
Description: In this course, we study of the physical principles of manufacturing processes. Main topics: properties of materials, alloys and phase diagrams, solidification processes, and powder metallurgy. Furthermore, this class presents the traditional and advanced techniques for processing metallic, polymeric, and composite materials. Main studied processes include: rolling, forging, extrusion, wiredrawing, coatings, cold-working on metal plates, metal machining, heat treatments, and welding.

IME 4003-Heat Transfer + Lab (3 Credits)
Class code: IME 4003
Pre-Requisite: IME 3201 Thermodynamics 1
Co-Requisite: Heat Transfer Lab
Description: This course covers the fundamental concepts of heat transfer by conduction, convection, and radiation. Additional topics include methods for determining heat transfer coefficients; combined modes of heat transfer; and heat exchangers.

General College Courses:
- Entrepreneurship. Class code: ADM 3002. (3 Credits)
- Design of Experiments. Class code: IIN 3005. (3 Credits)

8th SEMESTER

IME OPT - Energy Systems Design (Elective of Design) (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 4001 Fluid Mechanics
IME 3202 Thermodynamics 2
IME 4003 Heat Transfer
Co-Requisite: None
Description: This course is focused on the design of energy systems using fluid mechanics, thermodynamics, and heat transfer concepts. Topics covered include analysis and selection of thermal energy system components, as well as the simulation and optimization of different systems and energy components.

IME OPT Design for Manufacturability (Elective of Design) (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 4002 Materials Processing
Co-Requisite: None
Description: This course covers traditional and advanced manufacturing techniques used in processing metallic, polymeric, and composite materials used for single and series production under international standards. Students will develop a product considering optimal productivity factors and market demands. Additionally, they will ensure product quality by applying engineering criteria learned throughout their course of study.

IME OPT- Quality Management and Industrial Safety (Elective of Management) (3 Credits)
Class code: IME OPT
Pre-Requisite: MAT 2005 Statistics for Engineers
Co-Requisite: None
Description: Part 1 - Quality management: study of quality assurance fundamentals as well as the concepts of statistics applied to the control, management, and improvement of processes. Part 2 - Industrial safety: review of different methods to assure good health and prevent occupational diseases and accidents that can affect the physical and psychological integrity of the workers. Referential standards: ISO 9001 – 2008, ISO 9000 – 14000, and OHSAS 18001.

IME OPT - Reliability and Maintenance (Elective of Management) (3 Credits)
Class code: IME OPT
Pre-Requisite: MAT 2005 Statistics for Engineers
Co-Requisite: None
Description: This class is aimed at future mechanical, industrial, electrical, electronic, and chemical engineers. Basic concepts, techniques, technological, and administrative advances regarding maintenance, reliability, and risk are studied. Students learn through revision of theory and practice. The Case Study Method (CSM) is used in this class

IME 4301-Mechanical Design 1 (3 Credits)
Class code: IME 4301
Pre-Requisite: IME 3005 Solid Mechanics
Co-Requisite: None
Description: This course introduces the analyses and calculations necessary for mechanical element design. After reviewing the fundamentals of materials mechanics, static and fatigue failure theories for ductile and brittle materials are studied. These concepts are applied in the design of specific mechanical elements, such as shafts and fasteners.

IME 4004-Finite Element Method (3 Credits)
Class code: IME 4004
Pre-Requisite: IME 4003 Heat Transfer
IME 3005 Solid Mechanics
IME 3004 Computational Mechanics
Co-Requisite: None
Description: This introductory course covers the finite element theory and the terminology associated with continuous mechanics and transport of thermal energy. This is a course for senior-year undergrads with a strong background in calculus (differential and integral). Numerical solutions to heat transfer, solid mechanics, and coupled thermo-mechanical

equations are considered. The software used in the class for modeling is ABAQUS.

General College and Technical Elective Courses:

- ME Elective 1/2. Class code: IME OPT. (3 Credits)
- ME Elective 2/2. Class code: IME OPT. (3 Credits)
- Pre-professional internship PASEM. Class code: IME 4000. (0 Credits)

9th SEMESTER

IEE 4004-Industrial Automation (3 Credits)

Class code: IEE 4004
Pre-Requisite: IEE 2001 Basic Electronic
IME 3003 System Dynamics
Co-Requisite: Industrial Automation Lab
Description: This course covers fundamental concepts of practical industrial automation; operating principles of engines and industrial sensors; design concepts of circuits with contactors; pneumatic and electro-pneumatic actuators; operation of programmable controllers; and, industrial communication systems. Professional skills required for the integration and management of industrial equipment are also covered.

IIN 4003-Engineering Economics (3 Credits)

Class code: IIN 4003
Pre-Requisite: None
Co-Requisite: None
Description: This class studies the fundamental elements needed for the economic analysis of technical projects by applying techniques such as present value, annual value, rate of return, cost-benefit analysis, among others. Additionally, concepts of depreciation and inflation are presented. The use of spreadsheets for solving problems is referred and encouraged.

IME 5302- Mechanical Design 2 (Capstone Design) (3 Credits)

Class code: IME 5302
Pre-Requisite: IME 4301 Mechanical Design 1
Co-Requisite: None
The goal of this course is to apply all the knowledge and concepts learned throughout the Mechanical Engineering program to the analysis, design, construction, and testing of a functioning prototype or engineering system. Each project aims to solve an actual problem. Lectures, discussions, and guidance are provided along the entire design process, including final presentation and documentation of results. The lecture portion of this course provides guidance in planning and managing a project, as well as other topics associated with the design of machine elements, specifically gear design and selection (spur gears), rolling contact bearings, journal bearings, mechanical springs, and power transmissions. This course requires quality design, analyses, and experiments to support the design, construction, and testing of a system. Documentation of results and their professional presentation to a technical audience are required.

PREP TIT- Senior Project 1 (3 Credits)

Class code: PREP TIT
Pre-Requisite: None
Co-Requisite: None
Description: Senior Project I and Senior Project II are courses in which students work under the direction of a professor. These projects can be sponsored by companies, the University, or students themselves. Students work individually or in pairs. Students carry out their projects during two semesters, starting it in Senior Project I, and finishing it in Senior Project II.

Senior Project I includes weekly lectures conducted by a designated professor, and studio work, which is directed by the project's advising professor. During the lecture portion, students learn about design processes and innovation, as well as the contextualization of their projects with regards to topics that are relevant to the profession, including professional ethics, and the social, economic, political and sustainability impacts of engineering practice. In the studio portion, students apply what they have learned in the last years of their major to an actual design project, virtual design, investigation, or theoretical study. Projects can include conceptualization, analysis and simulation; prototype creation (in most cases); design of machines, energy systems, or products; and, their validation. Project requirements include submitting calculations (for sizing of components, energy balances, fluids, automatic control, etc.), technical drawings, performance tests of designs or prototypes, etc. Project deliverables include a written report documenting literature survey, design exploration, design iteration, mechanical drawings, engineering analysis, prototyping process, results, discussion, conclusions, and references.

Evaluation of this course is based on presentations and partial deliverables of the final project. It is expected that students will have carried out at least 50% of their projects by the end of Senior Project I.

General College and Technical Elective Courses:

- ME Elective 3/2. Class code: IME OPT. (3 Credits)
- ME Elective 4/2. Class code: IME OPT. (3 Credits)
- Learning and Service PASEC. Class code: PRC 2000. (0 Credits)

10th SEMESTER

IIN 5003-Project Management (3 Credits)

Class code: IIN 5003
Pre-Requisite: IIN IIN 4003 Engineering Economics
Co-Requisite: None
Description: The course covers project management tools within a specific methodological framework and as applied to actual situations. It highlights the importance of project management in entrepreneurial initiatives and innovation. The course's theoretical component is complemented with case-based learning and the use of technological tools.

IIN 5003- Senior Project 2 (3 Credits)

Class code: IIN 5003
Pre-Requisite: PREP TIT Senior Project 1
Co-Requisite: None
Description: Senior Project I and Senior Project II are courses in which students work under the direction of a professor. These projects can be sponsored by companies, the University, or students themselves. Students work individually or in pairs. Students carry out their projects during two semesters, starting it in Senior Project I, and finishing it in Senior Project II.

Senior Project II comprises studio work under the direction of the project's advising professor. During studio work, students apply what they have learned in the last years of their major to an actual design project, virtual design, investigation, or theoretical study. Projects can include conceptualization, analysis and simulation; prototype creation (in most cases); design of machines, energy systems, or products; and, their validation. Project requirements include submitting calculations (for sizing of components, energy balances, fluids, automatic control, etc.), technical drawings, performance tests of designs or prototypes, etc. Project deliverables include a written report documenting literature survey, design exploration, design iteration, mechanical drawings, engineering analysis, prototyping process, results, discussion, conclusions, and references.

Evaluation of this course contemplates both the final project report and a defense presentation before a committee designated by the Department. Senior Project II represents a continuation of the studio work started in Senior Project I, giving students the opportunity to develop their senior project more thoroughly, analyze their results, and defend their accomplishments in a presentation.

General College:

- GC – Social Sciences 3000. Class code CCSS 3000. (3 Credits)
- GC – Elective 2/2. Class code: ELECTIVA. (3 Credits)
- Colloquium. Class code: ING 0001. (0 Credits)

MECHANICAL ENGINEERING ELECTIVE COURSES

Industrial Automation and Control Area

ME OPT -Automatic Control + Problems (3 Credits)

Class code: IME OPT
Pre-Requisite: IME 3003 Dynamic of Systems
Co-Requisite: Problems in Automatic Control
Description: The course is focused on the analysis and design of control systems, with a focus on the latter's basic concepts. Course contents include Laplace transform; systems modeling; stationary and transient response; design of control systems using the roots locus method; design of control systems using frequency response; and, Design of PID controllers.

IME 0440-Introduction to Robotics + Lab (3 Credits)

Class code: IME 0440
Pre-Requisite: IEE0301 Electronic for Science and Engineering
CMP0213 Programming for Science and Engineering 1
MAT0221 Linear algebra
Co-Requisite: IME-0440L Introduction to Robotics Lab
Description: This course presents an introduction to mobile and industrial robotics. Students learn about sensors, actuators, programming, control, and mathematical modeling of robots. Students must build a mobile robot during the course

IME OPT -Instrumentation and Metrology + Problems +Lab (3 Credits)

Class code: IME OPT
Pre-Requisite: None
Co-Requisite: Problems in Instrumentation and Metrology
Instrumentation and Metrology Lab
Description: The course covers control, calibration, and verification of industrial instruments, as well as their use to specify the dimensions and properties of a system. Course contents include interpretation of measurements, specification tolerances, and allowed deviations, as well as the basic concepts of automation focused on measuring and measurement correction.

Design, Manufacturing and Materials Area

IME OPT -Materials Engineering 2 (3 Credits)

Class code: IME OPT
Pre-Requisite: IME 3101 Engineering Materials
Co-Requisite: None
Description: Materials Engineering 2 covers multiple ways to process materials to enhance their properties and performance when used in engineering applications. Main topics include: composite materials, biomaterials, smart materials, nanomaterials, semiconductors, sensor materials, etc. The students learn to identify advanced techniques to create new materials and new processes for their production.

IME OPT -Wear, Corrosion and Failure (3 Credits)

Class code: IME OPT
Pre-Requisite: IME 3101 Engineering Materials
Co-Requisite: None
Description: This course provides an overview on the processes and mechanisms involved in wear, corrosion and failure. Main topics covered include: failure formation; damage mechanisms; procedural approaches in failure analysis; metallographic and fractographic studies; non-destructive testing, among others. Additionally, the students discuss methods for corrosion control and prevention, including alloy selection, environmental control, cathodic protection, and protective coatings.

IME OPT -Steel Structures Design (3 Credits)

Class code: IME OPT
Pre-Requisite: IME 4004 Finite Element Methods
Co-Requisite: None
Description: This course is an introduction to steel design and construction. Main topics covered in this course are: structural steel, Load and Resistance Factor Design (LRFD) Method, AISC LRFD Specification, loads, members subjected to one or a combinations of tension, compression, bending, or torsion, connections, vertical column base plates, anchoring bolts. Class software: SAP, ABAQUS.

IME OPT- Automotive Engineering (3 Credits)

Class code: IME OPT
Pre-Requisite: IME 3002 Dynamics
IME 3201 Thermodynamics
IME OPT Elective of Mechanisms/ Vibrations
Co-Requisite: None
Description: This course covers the main systems that constitute an automobile and all the subsystems that are part of an engine, including their operating principles. The course

can motivate students to consider this field as a possible career path. Students will be able to apply knowledge acquired in this course to other subjects in the automotive field.

IME OPT -Plants and Processes (3 Credits)
Class code: IME OPT
Pre-Requisite: None
Co-Requisite: None
Description: This course presents engineering and management activities during the design of processing plants. Two case studies will be presented, which are representative of the local industry: (i) a crude processing plant and (ii) a power generation plant. Main topics: process engineering, pipe design, sizing of mechanical, electrical and control equipment. Finally, the students will be instructed in the civil engineering design of structures, foundations, drainages, etc.

Energy Area

IME OPT -Refrigeration and Air Conditioning (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 4001 Fluid Mechanics
IME 3201 Thermodynamics 1
IME 3202 Thermodynamics 2
Co-Requisite: None
Description: The course contemplates engineering design applications for air conditioning, mechanical ventilation, and cooling systems, reinforcing previously acquired knowledge of thermodynamics and fluid mechanics.

IME OPT -Renewable Energies (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 3201 Thermodynamics 1 or IME 4001 Fluids Mechanics
Co-Requisite: None
Description: This course is focused on energy use and the role of renewable energy sources. Different sources of renewable energy (wind, solar, geothermal, biomass, oceanic) are analyzed, both in terms of the current state of technology, and in terms of energy contribution to a system. General economic aspects of these sources are also covered.

IME OPT- Non-Renewable Energies (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 4001 Fluid Mechanics
IME 3201 Thermodynamics 1
Co-Requisite: None
Description: This class is intended for future mechanical, industrial, electrical, electronic, and chemical engineers who are interested in non-renewable energy sources based on fossil fuels. Course contents include history, processes, standards, and regulations concerning gas, oil, and coal production, as well as hydrocarbon applications and energy generation based on these products.

IME OPT -Turbomachinery (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 4001 Fluid Mechanics
IME 3201 Thermodynamics 1
Co-Requisite: None
Description: This course covers the application of fluid mechanic and thermodynamic principles to analysis and design of turbomachinery. It is focused on the conceptual and preliminary design of compressors, pumps, and axial and radial turbines, using velocity triangles and flow approach.

IME OPT -Computational Fluid Dynamics (CFD) (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 4001 Fluid Mechanics
IME 4004 Finite Element Methods
Co-Requisite: None
Description: This course covers the application of differential equations governing fluid flow, heat transfer, and mass transport towards solution of engineering problems. Students will use a computational fluid dynamics (CFD) software package during the course.

IME OPT -Aerodynamics (3 Credits)
Class code: IME OPT
Pre-Requisite: IME 4001 Fluid Mechanics
IME 3201 Thermodynamics 1
Co-Requisite: None
Description: This course covers the fundamental concepts of aerodynamics. It is aimed at mechanical and aerospace engineering students. Course contents include atmosphere; incompressible and compressible flows; measurement of flow velocity; two-dimensional flow; lift theories; airfoil theories; viscous flows; boundary layers; and, drag in incompressible flows.

General Field

IME OPT -Research and Development (3 Credits)
Class code: IME OPT
Pre-Requisite: None
Co-Requisite: None
Description: This course allows outstanding research-oriented students to participate in a guided project. There is no syllabus for the course. The opening of this class depends on the interest of student(s) and the availability of a professor to lead the project. For approval of the class, a committee of at least 3 professors will evaluate the project results.

Recent academic publications

Most recent publications

Scopus indexed publications

1. Gaona, Valarezo. Elastic modulus and thermal stress in coating during heat cycling with different substrate shapes. Frontiers of Mechanical Engineering, 2015. 10(3): p.294-300
2. Valarezo, Dviwedi, Sampath, Musalek, Matejicek. Elastic and Anelastic Behavior of TBCs Sprayed at High-Deposition Rates. Journal of Thermal Spray Technology, 2015. 24(1-2): p. 160-167
3. Varis, Suhonen, Ghabchi, Valarezo, Sampath, Liu, Hannula, Formation Mechanisms, Structure, and Properties of HVOF-Sprayed WC-CoCr Coatings: An Approach Toward Process Maps. J. Therm. Spray Technol., 2014. 23(6): p. 1009-1018.

4. Ruiz-Luna, Lozano-Mandujano, Alvarado-Orozco, Valarezo, Poblano-Salas, Trápaga-Martínez, Espinoza-Beltrán, Muñoz-Saldaña, Effect of HVOF Processing Parameters on the Properties of NiCoCrAlY Coatings by Design of Experiments. J. Therm. Spray Technol., 2014. 23(6): p. 950-961
5. Shinoda, Valarezo, Sampath. Effect of Deposition Rate on the Stress Evolution of Plasma-Sprayed Yttria-Stabilized Zirconia, J. Therm. Spray Technol., 2012. 21 (6): p. 1224-1233
6. Bolelli, Cannillo, Lusvarghi, Rosa, Valarezo, Choi, Dey, Weyant, Sampath. Functionally graded WC–Co/NiAl HVOF coatings for damage tolerance, wear and corrosion protection, Surface and Coatings Technology, Vol 206, Issues 8–9, 2012, p. 2585-2601.
7. Ozcan, S., Calderón, M. et al. (2015). Improved Mechanical Properties of Polylactide Nanocomposites-Reinforced with Cellulose Nanofibrils through Interfacial Engineering via Amine-Functionalization. Carbohydrate Polymers Journal. 10.1016/j.carbpol.2015.05.047
8. Emily A. Whitemarsh, David R. Escudero, Theodore J. Heindel, Probe effects on the local gas holdup conditions in a fluidized bed, Powder Technology, Volume 294, June 2016, Pages 191-201, ISSN 0032-5910, http://dx.doi.org/10.1016/j.powtec.2016.02.035.
9. Escudero DR, Heindel TJ. Characterizing Jetting in an Acoustic Fluidized Bed Using X-Ray Computed Tomography. ASME. J. Fluids Eng.2015; 138(4): 041309-041309-9. doi:10.1115/1.4031681.
10. E. A. Bonifaz. Finite Element Analysis of heat flow in single pass arc welds. American Welding Journal. Vol. 79, N□ 5, pp. 121-s to 125-s, May 2000.
11. E.A. Bonifaz, N.L. Richards. The Plastic Deformation of Non-Homogeneous Polycrystals: International Journal of Plasticity. Vol. 24, Issue 2, 2008, pp. 289–301.
12. E. A. Bonifaz, N. L. Richards. Modeling Cast IN-738 Superalloy Gas Tungten-Arc-Welds: Acta Materialia 57 (2009) 1785-1794.
13. E. A. Bonifaz, N. L. Richards. Stress-Strain Evolution in Cast IN-738 Superalloy Single Fusion Welds. International Journal of Applied Mechanics, Vol. 2, No. 4 (2010) 807–826 © Imperial College Press.
14. C. Churchman, E. A. Bonifaz, N.L. Richards. Comparison of Single Crystal Ni Based Superalloy Repair by Gas Tungsten Arc and Electron Beam Processes. Materials Science and Technology 2011 Vol. 27 No 4, pp 811-817.
15. E.A. Bonifaz. J. Baus, A. Czekanski. Finite element modelling of dual-phase polycrystalline Nickel-base alloys. Mechanics of Materials Journal 98 (2016) 134-141.
16. Portilla-Yandún, J., Cavaleri, L., & Van Vledder, G. P. (2015). Wave spectra partitioning and long term statistical distribution. Ocean Modelling, 96, 148-160. doi:10.1016/j.ocemod.2015.06.008
17. Portilla, J., Caicedo, A. L., Padilla-Hernández, R., & Cavaleri, L. (2015). Spectral wave conditions in the colombian pacific ocean. Ocean Modelling, 92, 149-168. doi:10.1016/j.ocemod.2015.06.005
18. Portilla, J., Sosa, J., & Cavaleri, L. (2013). Wave energy resources: Wave climate and exploitation. Renewable Energy, 57, 594-605. doi:10.1016/j.renene.2013.02.032

Other indexed publications

19. Sampath, Dwivedi, Valarezo, Choi. Partnership for accelerated insertion of new technology: case study for thermal spray technology, Integrating Materials and Manufacturing Innovation Journal, 2013, 2:1.
20. Ordoñez, Valarezo. Relaciones Proceso, Microestructura, Propiedades del Cromado Duro a Escala de Laboratorio. Avances en Ciencia e Ingeniería, 2015. 7(2): p.C69-C79
21. Harichabal, Hellen et al. Premio Odebretch 2014: Los mejores 10 Proyectos. Odebretch, 2014. 1(1): p.126-138
22. E. A. Bonifaz, A. Martín Meizoso, J.M. Martínez Esnaola, J. Gil Sevillano. Simulación del comportamiento elastoplástico de estructuras bifásicas policristalinas de aceros "dual-phase". Bol. Soc. Esp. Ceram. Vidrio, 39 [3] 341-343 (2000).
23. E. A. Bonifaz. Thermo-Mechanical Modeling of Single Fusion Welds: Canadian Welding Association Journal - summer 2007, pp. 13-20.
24. E. A. Bonifaz. Strain Hardening of Crystalline Materials. Avances en Ciencias e Ingenierías, 2010, Vol. 2, Págs. C1-C3.
25. E. A. Bonifaz (2011). Cohesive zone modeling to predict failure processes. Canadian Journal on Mechanical Sciences & Engineering Vol. 2, No. 3, March 2011, pp 42-54. http://www.ampublisher.com/Mar%202011/MSE%20Mar%202011.html
26. E. A. Bonifaz. Multiscale Simulations in Welds. Avances en Ciencias e Ingenierías, December 2012, Vol. 4, No. 2, Pags. C1-C5.
27. E. A. Bonifaz, C. Rivadeneira. Finite Element Modeling in Premolar Teeth. Avances en Ciencias e Ingenierias, 2013, Vol. 5, No. 2, Pags. C90-C94.
28. F. Oviedo, L. Trojman, T. Kauerauf, E. A. Bonifaz. Thermal-Electrical finite element analysis of nanometric copper vias under high fluence. Avances en Ciencias e Ingenierias, 2013, Vol. 5, No. 2, Pags. C35-C40.
29. E. A. Bonifaz. Application of Thermo-Mechanical Modeling to Fusion Welding. Canadian Welding Association Journal - summer 2015, pp 34-39.
30. E. A. Bonifaz. Sub modeling simulations in fusion welds: PART I. Journal of Multiscale Modelling Vol. 4, No. 4 (2013) 1250014 (10 pages).
31. E. A. Bonifaz. Sub modeling simulations in fusion welds: PART II. Journal of Multiscale Modelling Vol. 5, No. 2 (2014) 1350008 (11 pages).
32. E. A. Bonifaz. Finite element modeling to simulate the elasto-plastic behavior of polycrystalline in 718. Journal of Multiscale Modelling, Vol. 5, No. 2 (2014) 1350011 (14 pages). http://dx.doi.org/10.1142/S175697371350011X
33. E. A. Bonifaz, A. Czekanski. Multiscale Simulations in a Butt Fusion Weld. International Journal of Aerospace and Lightweight Structures, Vol. 4, No. 4 (2014), 273–280. © Research Publishing Services doi:10.3850/S2010428614100028.
34. Soria, Cabrera & Guerra. Design and Construction of a ROV (Remotely Operated Vehicule) Submarine USFQ. Avances en Ciencias e Ingenieria, 2014, Vol. 6, No. 1, Pags. C27-C37
35. Portilla-Yandún, J. Análisis de oleaje en el sector de Bajoalto, El Oro, Ecuador. (2012)
36. Portilla-Yandún, J. Storm-Source-Locating Algorithm Base don the Dispersive Nature of Ocean Swells. (2012). Avances en Ciencias e Ingenierias. Vol4, No1, Pags C22-C36

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- Bertarelli, A., Calderón, M. et al. (2013). First Results of an Experiment on Advanced Collimator Materials at CERN HiRadMat Facility. International Particle Accelerator Conference 2013, in Shanghai, China. INSPIRE-1337343
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- E. A. Bonifaz, A. Martín Meizoso, J.M. Martínez Esnaola, J. Gil Sevillano. Assessment of the contribution of plastic strain gradients effects to the fatigue threshold of ductile materials. The 13th European Conference on Fracture. Fracture Mechanics: Applications and Challenges, 6th – 9th September 2000, San Sebastian, Spain. Edited by: M. Fuentes, M. Elices, ESIS-Elsevier.
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- E. A. Bonifaz. Stress-Strain evolution in Single Fusion Welds. 50th ANNIVERSARY CONFERENCE Engineering: Science and Technology, Universidad de Navarra-Spain, May 31-Jun 1, 2012
- N.F. Soria, M.K. Colby, I.Y. Tumer, C. Hoyle, K. Tumer, “Design of complex engineering systems using multiagent coordination.” ASME IDETC/CIE 2016. IDETC2016-59570. Charlotte, NC. 2016.
- C.A. Manion, N.F. Soria, K. Tumer, C. Hoyle, I.Y. Tumer, “Designing a self-replicating robotic manufacturing factory.” ASME IDETC/CIE2015. IDETC2015-47628. Boston, MA. 2015.

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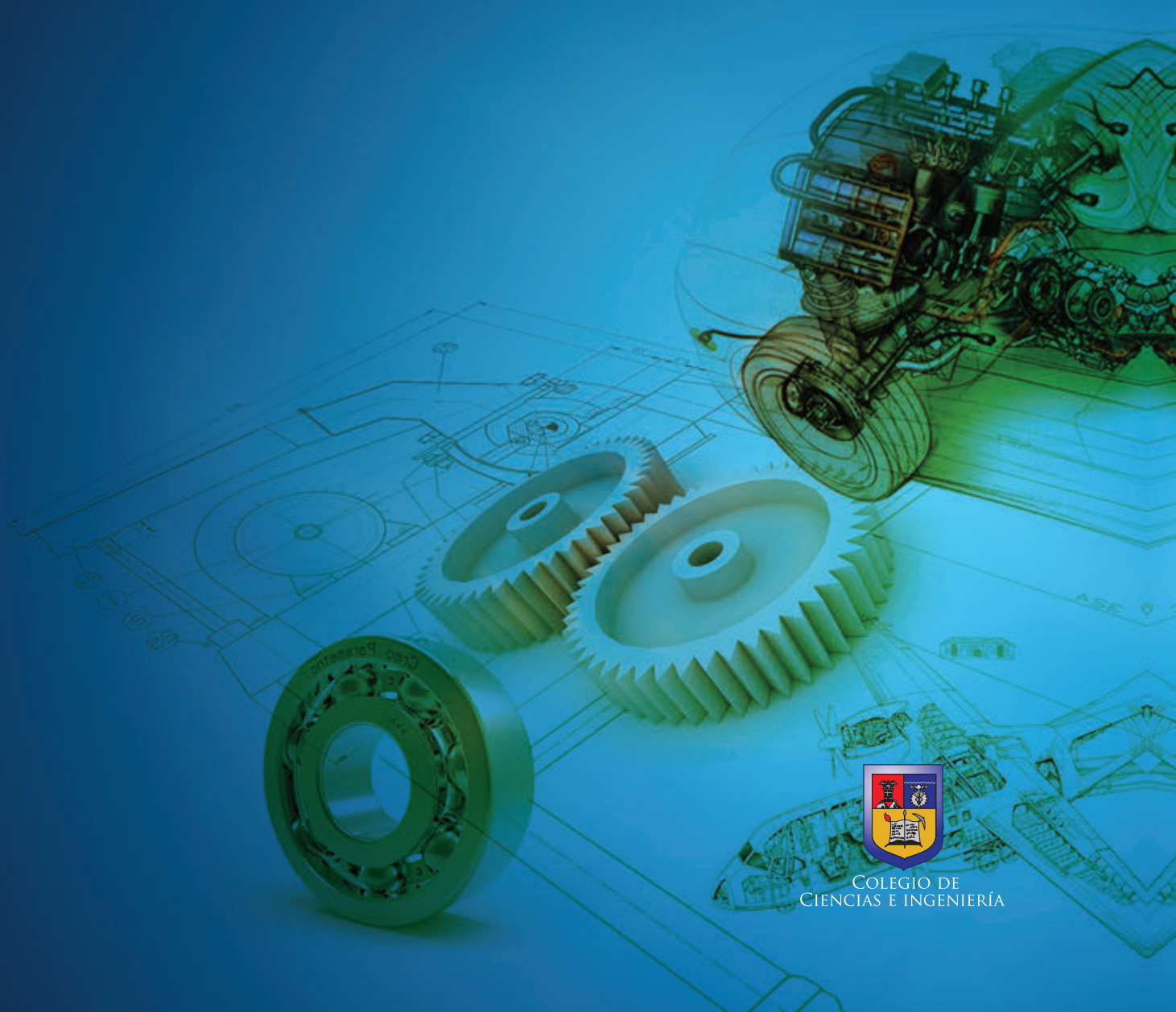

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