FEDERAL UNIVERSITY OF SANTA CATARINA
TECHNOLOGICAL CENTER OF JOINVILLE
JOINVILLE CAMPUS

COURSE PEDAGOGICAL PROJECT (CPP)

BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (CURRICULUM 2025/1)

JOINVILLE
DECEMBER/ 2024

AUTOMOTIVE ENGINEERING PROGRAM COUNCIL
ORDINANCE No. 074/2021/DCTJ, DATED JULY 1, 2021
AND ORDINANCE No. 036/2020/DCTJ, DATED AUGUST 10, 2020

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AUTOMOTIVE ENGINEERING NDE
ORDINANCE No. 055/2020/DCTJ, DATED SEPTEMBER 10, 2020

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SUMMARY

1 PROGRAM

Program Name

Bachelor's Degree in Automotive Engineering

Degree Awarded

Automotive Engineer

Course Duration

Minimum completion: 5 years (10 semesters)

Maximum completion: 9 years (18 semesters)

Field of Knowledge

Specific Area: Mechanical Engineering / Automotive Engineering

Qualification

Automotive Engineering

Number of seats offered per semester

25 seats (50 seats per year)

Number of students currently enrolled (as of 11/26/2021)

229 students

Planned study shifts

Full-time

Year and semester of program start

2009/02

Recognition Act

Ordinance No. 1027 of 05/15/2006 (Ministry of Education, 2006) and published in the Official Gazette on 05/16/2006; Ordinance No. 921 of 12/27/2018 (Ministry of Education, 2018) and published in the Official Gazette on 12/28/2018; Normative Ordinance No. 40/2007/MEC, Article 63 (Ministry of Education, 2007).

Admission process

Annual entrance exam (Vestibular) and SISU

Number of weekly class credits

Minimum of 14 credits and maximum of 26 credits

Program Coordinator

Prof. Sérgio Junichi Idehara

2 INTRODUCTION

The present Pedagogical Course Project (PPC) for Automotive Engineering is proposed in 2021/2022 as an update of the program in accordance with current legislation and professional market trends. The document and pedagogical strategies are developed by the members of the NDE (Structuring Teaching Nucleus) and the Program Council, based on proposals suggested by faculty groups and thematic areas that make up the Joinville Campus. The terms presented in the PPC are mandatory curricular components of the program. This document updates the previous project, from 2016, to comply with the Guidelines for Extension in Higher Education, regulated by Resolution No. 7 of the Ministry of Education, dated December 18, 2018 (National Education Council, 2018), and the National Curriculum Guidelines for Undergraduate Engineering Programs, dated April 24, 2019, regulated by Resolution CNE/CES 2/2019 (Ministry of Education, 2019).

2.1 DOCUMENTS CONSULTED FOR THE ELABORATION OF THE PPC

As normative references for the elaboration of this PPC of the Automotive Engineering program, the following documents were consulted:

2.1.1 INTERNAL LEGISLATION AND REGULATIONS

- Joint Circular Letter No. 004/2021/PROGRAD/PROEX, April 22, 2021 – deadlines for submission to DEN/PROGRAD and possible implementation of Pedagogical Projects, in accordance with groups established in the joint meeting of PROGRAD, PROEX, and Center Boards in May 2019 (Office of Extension, 2021);
- Circular Letter No. 2/2020/DEN/PROGRAD, March 13, 2020 – General guidelines on the implementation of curricular extension policy for programs (Office of Undergraduate Studies, 2020);
- Normative Resolution 01/2020/CGRAD/CEx, March 3, 2020 – Provides for the inclusion of Extension activities in the curricula of undergraduate programs at the Federal University of Santa Catarina (UFSC, 2020);
- Institutional Development Plan (PDI) 2020–2024 (UFSC, 2019);
- Normative Resolution No. 117/2018/CUn, February 27, 2018 – Adds paragraphs to Article 10-A of Resolution No. 017, September 30, 1997 (University Council, 2018);
- Normative Resolution No. 88/2016/CUn, October 25, 2016 – Establishes the regulations governing extension activities at UFSC (University Council, 2016);
- Normative Resolution No. 73/2016/CUn, June 7, 2016 – Regulates curricular internships for undergraduate students at UFSC (University Council, 2016);
- BECKERT, Sueli. Report on the Implementation of the REUni Program at UFSC Joinville Campus, 2009–2014. UFSC, CEM Joinville Campus, 2014;
- UFSC Ordinance No. 233, August 25, 2010 – Establishes the Structuring Teaching Nucleus (NDE) within undergraduate programs and defines its operating rules and responsibilities (UFSC, 2010);
- Resolution No. 018/CUn/2004, November 30, 2004 – Provides the regulations for undergraduate programs (University Council, 2004);
- Resolution No. 005/CUn/2001, May 29, 2001 – Provides for the Extraordinary Academic Achievement Assessment Exam (UFSC, 2001);

- UFSC Resolution No. 17/CUn/97, September 30, 1997 – Undergraduate program regulations (University Council, 1997);
- Resolution No. 03/CEPE/84, April 5, 1984 – Guidelines for the Teaching Planning of Undergraduate Courses (UFSC, 1984);
- UFSC General Regulations (Federal University of Santa Catarina, 1982);
- UFSC Statute (Federal University of Santa Catarina, 1978).

2.1.2 EXTERNAL LEGISLATION AND REGULATIONS

- Resolution No. 1, March 26, 2021 – Amends Art. 9, §1 of Resolution CNE/CES 2/2019 and Art. 6, §1 of Resolution CNE/CES 2/2010, which established the National Curriculum Guidelines for Undergraduate Programs in Engineering, Architecture, and Urbanism (Ministry of Education, 2021);
- CNE/CES Resolution No. 1, December 29, 2020 – Establishes deadlines for the implementation of new National Curriculum Guidelines (DCNs) during the public emergency caused by the COVID-19 pandemic (Official Gazette of the Union, 2020);
- Ministerial Dispatch, December 24, 2020, by Minister of Education Milton Ribeiro – Extends deadlines for new National Curriculum Guidelines, including CNE/CES Resolution No. 7/2018, which establishes guidelines for Extension in Higher Education. The deadline for implementing Extension in undergraduate curricula at Brazilian HEIs was extended to December 19, 2022 (Official Gazette of the Union, 2020);
- Table of Professional Titles, Resolution 473/02 – Last update: 06/05/2020 (CONFEA, 2020);
- MEC Ordinance No. 2.117, December 6, 2019 – Provides regulations for Higher Education Institutions (HEIs) to offer part of their undergraduate program credits through distance learning (Official Gazette of the Union, 2019);
- Resolution No. 2, April 24, 2019 – Establishes the National Curriculum Guidelines for Undergraduate Engineering Programs (Ministry of Education, 2019);
- Glossary (4th Edition) of the External Evaluation Instrument by INEP (INEP, 2019);
- Resolution No. 7, December 18, 2018 – Establishes the Guidelines for Extension in Brazilian Higher Education and regulates the provisions of Goal 12.7 of Law No. 13.005/2014, which approved the National Education Plan – PNE 2014–2024 (National Education Council, 2018);
- Law No. 13.425, March 30, 2017 – Establishes general guidelines for fire prevention and disaster response measures in establishments, buildings, and public gathering spaces (Official Gazette of the Union, 2017);
- Evaluation Instrument for On-Campus and Distance Undergraduate Programs (INEP/SINAES) – Recognition and renewal of recognition (INEP/MEC, 2017).
- Resolution CONFEA No. 1073, April 19, 2016 – Regulates the attribution of titles, activities, competencies, and professional fields of practice to professionals registered in the Confea/Crea System for the purpose of supervising professional practice in Engineering and Agronomy (CONFEA, 2016);
- Law No. 13.168, October 6, 2015 – Public Data – Amends §1 of Art. 47 of Law No. 9.394, December 20, 1996 (National Education Guidelines and Framework Law) (Brazil, 2015);
- Law No. 13.146, July 6, 2015 – Institutes the Brazilian Law of Inclusion of Persons with Disabilities – Statute of Persons with Disabilities (Brazil, 2015);

- MEC Technical Note 793, May 12, 2015 – Undergraduate Curriculum. Frequently asked questions (Ministry of Education, 2015);
- Resolution CNE No. 1, May 30, 2012 – Establishes National Guidelines for Human Rights Education (CNE, 2012);
- National Education Plan – PNE 2014–2024 (Brazil, 2015);
- CNE/CP Opinion No. 8/2012 – Opinion on the National Guidelines for Human Rights Education (Ministry of Education, 2012);
- Law No. 12.527, November 18, 2011 – Law on Access to Information (Brazil, 2011);
- CONAES Opinion No. 4, June 17, 2010 – On the Structuring Teaching Nucleus – NDE (National Commission for the Evaluation of Higher Education, 2010);
- Document prepared by the Working Group established by SESU/MEC Ordinance No. 383, April 12, 2010 – Guiding references for interdisciplinary bachelor's degrees and similar programs (Ministry of Education, 2010);
- Law No. 12.089, November 11, 2009 – Prohibits one person from holding two simultaneous seats in public higher education institutions (Brazil, 2009);
- Law No. 11.645, March 10, 2008 – Amends Law No. 9.394, December 20, 1996, modified by Law No. 10.639, January 9, 2003, to include in the official curriculum of the school system the mandatory study of "Afro-Brazilian and Indigenous History and Culture" (Brazil, 2008);
- Resolution No. 3, July 2, 2007 – Establishes procedures regarding the definition of the teaching-hour concept, and other provisions (Ministry of Education, 2007);
- CNE/CES Resolution No. 2, June 18, 2007 – Provides on minimum credit hours and procedures for the completion and duration of undergraduate bachelor's degree programs, in the on-campus modality (Ministry of Education, 2007);
- Decree No. 6.096, April 24, 2007 – Establishes the Program for Supporting Restructuring and Expansion Plans of Federal Universities – REUNI (Presidency of the Republic, 2007);
- Decree No. 5.626, December 22, 2005 – Provides for the Brazilian Sign Language – Libras (Brazil, 2005);
- Resolution CNE No. 1, June 17, 2004 – Establishes National Curriculum Guidelines for the Education of Ethnic-Racial Relations and for the Teaching of Afro-Brazilian and African History and Culture (CNE, 2004);
- CNE/CP Opinion No. 003/2004 – Opinion on the National Curriculum Guidelines for the Education of Ethnic-Racial Relations and the Teaching of Afro-Brazilian and African History and Culture (Ministry of Education, 2004);
- Decree No. 4.281, June 25, 2002 – Regulates Law No. 9.795, April 27, 1999, which establishes the National Environmental Education Policy (Brazil, 2002);
- CNE/CES Resolution No. 11, March 11, 2002 – Establishes the National Curriculum Guidelines for undergraduate Engineering programs (Higher Education Chamber of the National Education Council, 2002);
- Law No. 9.795, April 27, 1999 – Provides for environmental education, establishes the National Environmental Education Policy, and other provisions (Brazil, 1999);
- Law No. 9.394/96, December 20, 1996 – Brazilian Education Guidelines and Framework Law – LDB (Brazil, 1996);
- CONFEA Resolution No. 218, June 29, 1973 – Defines the activities of different professional fields in Engineering, Architecture, and Agronomy (CONFEA, 1973);
- Constitution of the Federative Republic of Brazil, 1988 (Brazil, 1988).

3 FEDERAL UNIVERSITY OF SANTA CATARINA

3.1 BRIEF HISTORY

The Federal University of Santa Catarina (UFSC) was established in December 1960. Its first Rector, Professor João David Ferreira Lima, was selected from a shortlist of three candidates and took office on October 25, 1961. At that time, the university had 847 students and 49 faculty members, originating from seven independent colleges, along with one newly created. Among these seven colleges, the Schools of Pharmacy and Dentistry, Law, and Economics had their roots in the Polytechnic Institute, founded in 1917 with support from the state government, and the Academy of Commerce, a private institution subsidized by the state, which absorbed the Polytechnic Institute in the 1930s. In the years following its foundation, the Polytechnic Institute offered the first higher education courses in technical areas in the state. Thus, UFSC represented a significant milestone in the evolution of higher education in Santa Catarina. The chronological sequence of the founding colleges is as follows:

1. Law School of Santa Catarina, founded in 1932 and federalized by Law No. 3.038, December 19, 1956;

2. School of Economics of Santa Catarina, founded in 1943 and recognized by Decree No. 37.994, September 28, 1955;

3. School of Pharmacy of Santa Catarina, created in 1960 from the split of the School of Pharmacy and Dentistry of Santa Catarina, originally founded in 1946 and recognized by Decree No. 30.234, December 4, 1951;

4. School of Dentistry of Santa Catarina, also created from the split of the School of Pharmacy and Dentistry of Santa Catarina;

5. Catarinense School of Philosophy, founded in 1951 and recognized by Decrees No. 46.266, June 26, 1959, and No. 47.672, January 19, 1960;

6. School of Social Work, from the Vidal Ramos Foundation, as an affiliated institution, authorized by Decree No. 45.063, December 19, 1958;

7. School of Medicine of Santa Catarina, authorized by Decree No. 47.531, December 29, 1959;

8. School of Industrial Engineering, with programs in Chemistry, Mechanical, and Metallurgy, authorized by the very law that created the University.

UFSC's legal foundation for its creation was Law No. 3,849, of December 18, 1960. At that time, the State of Santa Catarina mirrored the national scenario and was experiencing a period of economic growth, consolidating industrial sectors such as ceramics in the south, paper, cardboard, and mechanical pulp mainly in the Itajaí Valley and in the Lages plateau, and metal-mechanics in the north. The economic environment was therefore very favorable to the expansion of higher education. The initial project in Santa Catarina was to establish a

state university, which was accomplished five years after the creation of UFSC with the establishment of the University for the Development of the State of Santa Catarina (UDESC), now named State University of Santa Catarina. The history of these two pioneering universities in the state has been interconnected from the beginning. Like other universities supported by the Federal Government, the University of Santa Catarina was designated a Federal University by Law No. 4,759, of August 20, 1965. With the university reform of 1969 (Decree No. 64.824, of July 15, 1969), the University acquired its current administrative structure. The former colleges were replaced by university units, called centers, which comprise the departments.

At present, UFSC has a total of eleven Teaching Centers located in the city of Florianópolis.

- Center of Agricultural Sciences (CCA)
- Center of Biological Sciences (CCB)
- Center of Education Sciences (CED)
- Center of Health Sciences (CCS)
- Center of Physical and Mathematical Sciences (CFM)
- Center of Legal Sciences (CCJ)
- Center of Communication and Expression (CCE)
- Center of Sports (CDS)
- Center of Philosophy and Human Sciences (CFH)
- Socioeconomic Center (CSE)
- Technological Center (CTC)

In basic education, the UFSC Laboratory School (Colégio de Aplicação) and the Child Development Center (NDI), created in 1961 and 1980 respectively, provide education from early childhood through elementary and high school. Beyond teaching, they also serve as supervised internship and research fields for UFSC students and faculty, as well as for those from other public institutions. They engage in both research and extension activities, consolidating themselves as spaces for training, knowledge production, and knowledge sharing. In distance education, UFSC began in 1995 with the Distance Learning Laboratory (LED), focusing on research and professional development through extension projects. These were offered as specialization courses delivered via satellite-generated video lectures. In more recent years, several groups have engaged in distance education initiatives within the Open University of Brazil (UAB) Project, which enabled the development of infrastructure for offering extension, undergraduate, and specialization courses throughout much of the country, contributing to the University's expansion.

In on-campus education, UFSC's participation in the Program for Support of Federal University Restructuring and Expansion Plans (REUNI) in 2008 significantly expanded the number of programs and student seats offered. Using resources from this program, UFSC created and launched, in 2009, three new campuses in Araranguá, Curitibanos, and Joinville, the latter hosting the program addressed in this PPC. Finally, in 2014, the Blumenau campus was added to this group of new campuses.

Thus, at present, UFSC has four Teaching Centers located in these campuses:

- Center of Sciences, Technologies and Health (CTS) – Araranguá Campus
- Center of Technology, Exact Sciences and Education (CTE) – Blumenau Campus
- Center of Rural Sciences (CCR) – Curitibanos Campus
- Technological Center of Joinville (CTJ) – Joinville Campus

The Automotive Engineering program described in this PPC is housed within the Technological Center of Joinville (CTJ).

3.2 MISSION, VISION AND VALUES

3.2.1 MISSION

The Federal University of Santa Catarina has the mission to "produce, systematize and share philosophical, scientific, artistic, and technological knowledge, broadening and deepening human development for professional practice, critical reflection, national and international solidarity, in the perspective of building a just and democratic society and in the defense of quality of life."

3.2.2 VISION

To be a university of excellence.

3.2.3 VALUES

UFSC must increasingly affirm itself as a center of academic excellence at the regional, national, and international levels, contributing to the construction of a just and democratic society and to the defense of quality of life, based on the following values:

- Academic and Quality-Oriented: An institution that continuously seeks the highest levels of academic excellence in all its areas of activity, especially in teaching, research, and extension.
- Innovative and Entrepreneurial: An institution capable of identifying, creating, implementing, supporting, and encouraging new opportunities, initiatives, careers, actions, and innovative and entrepreneurial practices.
- Active: An institution capable of providing input, influencing, and proposing solutions to major issues, such as access to knowledge and citizenship, environmental sustainability, and scientific, technological, economic, human, and social development.
- Inclusive: An inclusive university, able to embrace diverse social groups and foster an environment where respect and interaction with all diversities, nationalities, classes, ethnicities, and people with disabilities prevail, committed to democratizing access to free, high-quality public higher education for all, overcoming inequality, prejudice, exclusion, or discrimination, and building a fairer and more harmonious society for future generations.
- Internationalized: A reference institution in the internationalization of higher education, capable of strengthening partnerships and agreements with international institutions in various fields of research, teaching, and extension, with an ethical commitment to both national and international academic communities, promoting the development of the University, Brazil, and other nations.
- Interdisciplinary: An institution prepared to foster mutual interaction among diverse areas of teaching, research, and extension, so that these dialogues resonate in building a university of ever-greater excellence.
- Free and Responsible: An institution where students, faculty, and staff are free and responsible to pursue their convictions and vocations. A university

where freedom and responsibility guide academic, administrative, and scientific creation and decision-making, as well as inter-institutional relationships and partnerships, both nationally and internationally.

- Autonomous: An institution capable of determining its own path, within its competencies, with responsibility and transparency.
- Democratic and Plural: An institution committed to democratizing access to free, high-quality public higher education, ensuring full recognition of its academic diversity, providing space for ideological pluralism, and above all, respect for every personal, academic, ethnic, cultural, and intercultural difference and diversity. Additionally, an institution that values full openness to dialogue and participation, with a commitment to democratic and civic practice.
- Dialogical: An institution that promotes dialogue not only among its students, faculty, and staff but also between the University and society as a whole, thereby encouraging the co-production of knowledge for scientific, technological, economic, human, and social development.
- Well-Managed and Planned: An institution with efficient and effective strategies for management and resource acquisition to achieve its goals, operating with excellence while maintaining a less bureaucratic structure.
- Transparent: An institution that is accountable for its actions and decisions to the community.
- Ethical: An institution guided by ethical, social, and environmental responsibility.
- Healthy: A university committed to fostering harmonious human relations, maintaining sustainable and healthy environments and infrastructure, and promoting education for health. It multiplies healthy practices and holistic care, ensuring longevity and quality of life.
- Sustainable: An institution capable of promoting not only sustainability but also responsible and ethical awareness regarding environmental issues, encouraging concern for humanity and future generations, where economic and social development is built alongside environmental preservation.

3.3 OBJECTIVES

The vision of becoming a university of excellence requires the development of innovative actions in the following areas: teaching, research, extension, culture and arts, and management. These actions involve objectives and targets for each dimension. For teaching, the objectives are designed to integrate policies across basic education, undergraduate, and graduate studies. Key goals include innovative actions in teaching practices and strengthening the social impact of lato sensu graduate programs. Additionally, efforts aim to broaden qualified access to the University and institutionalize relationships with alumni. For research, the objectives are to better institutionalize research, expand infrastructure, and reinforce its social role. Social responsibility and the integration of the University at both regional and international levels must also be strengthened. For extension, the goal is to intensify community interaction and collaboration with organized sectors of society. For culture and arts, the objective is to improve the artistic and cultural environment through interdisciplinary reflection on culture and society, involving different university units and disseminating arts and culture across the state of Santa Catarina.

Finally, in the area of management, the primary objective is the institutionalization of a planning system that distinguishes between different time horizons, with particular emphasis on long-term vision. Additional goals in this area include: strengthening the professional development of administrative and teaching staff, updating infrastructure and management systems, and professionalizing UFSC's relationships with external agencies that affect university life. These objectives serve as a guide for setting the University's goals for the next five years. In line with its Mission, UFSC incorporates ethical, social, welfare, and accessibility responsibilities across all its practices, ensuring the inseparability of teaching, research, and extension as its core pillars.

3.4 ACTIVITIES

In accordance with its institutional mission, UFSC fulfills the role of producing, systematizing, and disseminating philosophical, scientific, artistic, and technological knowledge, ensuring the inseparability of teaching, research, and extension across all major fields of knowledge and levels of academic training. Thus, teaching, research, and extension do not operate in isolation. From these pillars, transversal areas also emerge. These areas intersect with the main academic activities and, supported by governance resources, aim to achieve the University's Mission and Vision. Transversal areas are themes that cut across all fields of knowledge, corresponding to pressing and relevant issues in society. They are not exclusive to a specific academic field, but permeate them all. The following transversal areas stand out: Culture and Arts; Sports, Health and Leisure; Technology, Innovation and Entrepreneurship; Internationalization; Interdisciplinarity; Social Inclusion and Diversity; and Environmental Sustainability.

UFSC offers education at all levels: from basic education to undergraduate and graduate studies. The Child Development Center (NDI) and the Laboratory School (Colégio de Aplicação – CA) provide basic education with reserved seats for students with disabilities. In higher education, students enroll in undergraduate programs either on-campus or through distance learning, across different schedules, degrees, and modalities (licentiate and bachelor's). At the graduate level, UFSC offers doctoral, academic master's, and professional master's programs (stricto sensu). Over the last decades, graduate education has significantly advanced in the generation and dissemination of knowledge, alongside the consolidation and creation of new laboratories, institutes, and research centers. According to data from the Institutional Development Plan (PDI 2020–2024), about 50,000 people circulate daily through UFSC's facilities, including faculty, administrative staff, students of all levels, and the external community. The University employs over 5,600 staff members (2,495 faculty and 3,129 administrative staff), and serves approximately 1,190 students in basic education, around 30,000 students enrolled in 120 undergraduate programs (107 on-campus and 13 distance learning), more than 8,000 students in stricto sensu graduate programs (65 academic master's, 21 professional master's, and 56 doctoral programs), and about 2,000 students in lato sensu programs (seven specializations).

In the most recent evaluation of the National Graduate System, conducted by CAPES (Coordination for the Improvement of Higher Education Personnel), 17 of the 56 evaluated programs received scores of 6 and 7—the highest possible. Furthermore, 62.5% of programs achieved a score of 5 or higher. This commitment to excellence and solidarity has enabled UFSC to attain high levels of qualification, confirmed by recent national and international rankings. UFSC stands out among the best universities in Brazil in every evaluation conducted. This recognition is supported by the strong academic qualifications of its faculty,

the quality of its undergraduate and graduate programs, the expertise of its technical-administrative staff (STAE) in supporting research, the volume of its scientific production, and its strong connections with companies and productive sectors both regionally and nationally. With the goal of making its knowledge and cultural resources accessible to society—whether derived from its own production or from the systematization of available universal knowledge—UFSC has, in recent years, developed numerous extension activities. These initiatives are carried out through interdisciplinary and multidisciplinary actions involving professors, students, and technical-administrative staff, reinforcing the University's mission of social commitment and knowledge transfer.

3.5 INSTITUTIONAL POLICIES OF THE PDI

UFSC's policies for the five-year period 2020–2024 focus on the consolidation of strategic management practices, complemented by organizational management and the support structure for teaching, research, extension, and other transversal areas. The dimensions considered according to the Institutional Development Plan – PDI 2020–2024 (UFSC, 2019) are: teaching, research, extension, and management. To support all these dimensions, a Governance area was created, ensuring that the University's administrative scope is also aligned with institutional objectives and capable of supporting the other areas.

3.5.1 TEACHING

The teaching policy emphasizes the preparation of individuals to understand and act effectively in society, aiming to educate citizens with an inter- and multidisciplinary vision of their field, global thinking in their actions, and high ethical standards. To ensure learning excellence, teaching is based on the development of competencies, skills, and attitudes, through diverse pedagogical practices essential for qualified education. Such practices include: Theoretical classes using innovative educational technologies, Laboratory and fieldwork, Thesis/monograph development, Tutoring and internship activities, Participation in research projects, scientific initiation, and extension activities, Attendance at congresses, events, workshops, and colloquia, among others. Through the updating and modernization of regulations, UFSC seeks to institutionalize research laboratories and researcher groups (whether or not engaged in bilateral or multilateral agreements) and to foster agreements with national and international teaching and research institutions. Institutional teaching objectives include:

- Offering programs of excellence;
- Strengthening policies for student selection, access, inclusion, retention, and success;
- Expanding undergraduate and graduate programs, both on-campus and distance learning;
- Promoting interaction with alumni;
- Ensuring and expanding cultural, artistic, and literary environments;
- Encouraging sports, leisure, and health promotion in student training;
- Promoting innovation and entrepreneurship in student education;
- Developing global and intercultural competencies;
- Expanding exchange programs;
- Strengthening and encouraging curricular and extracurricular interdisciplinarity;
- Developing pedagogical, academic, and support actions, as well as affirmative actions, appreciation of diversity, and inclusion of people with disabilities;
- Encouraging the integration of environmental sustainability at all levels of education.

3.5.2 RESEARCH

Research aims at the generation and expansion of knowledge, necessarily linked to scientific and technological creation and production, while adhering to its specific ethical standards, particularly when involving humans, animals, or fragile environments and species. At UFSC, greater emphasis will be placed on strengthening the institutional environment for research development, increasing the number of research groups, expanding the related infrastructure through the implementation of new institutional multi-user laboratories, constructing physical infrastructure, and hiring qualified personnel for research development. This includes supporting the new campuses and fostering the training and consolidation of new researchers. The institutional objectives of the research dimension are:

- Stimulate and promote research in all areas and levels;
- Expand, improve, and consolidate research infrastructure;
- Bring research closer to different segments of society;
- Stimulate cultural and artistic research and production;
- Encourage research in sports, health, and leisure;
- Promote Research and Development focused on innovation and entrepreneurship;
- Strengthen technical and scientific relations;
- Stimulate the creation of projects in multi-user laboratories;
- Expand the participation of affirmative action students in research;
- Encourage research in the area of environmental sustainability.

3.5.3 EXTENSION

UFSC is committed to building and consolidating an extension policy aligned with the guidelines established by the National Policy on University Extension, defined by the Forum of Pro-Rectors of Extension of Brazilian Public Higher Education Institutions. To this end, it will support extension activities with available resources and through partnerships with the State and Federal Government, as well as with organized sectors of society. UFSC also intends to serve as an important agent for the full dissemination of knowledge by presenting to society the results of its teaching, research, and extension activities, while simultaneously acting as a producer of new knowledge derived from acquired experiences. The institutional objectives of the extension dimension are:

- Improve and expand extension activities;
- Support student organizations;
- Train the internal community for the development of extension initiatives;
- Stimulate and foster cultural, artistic, and literary projects;
- Consolidate sports, health, and leisure as institutional practices;
- Boost extension activities focused on innovation and entrepreneurship;
- Promote extension practices aimed at internationalization;
- Foster interaction among different areas in extension activities;
- Develop extension projects that promote social inclusion and respect for diversity;
- Promote environmental and social awareness and reflection within the university community and external society.

3.5.4 MANAGEMENT

The management policy for the next five years will focus on the consolidation of strategic management practices — always complemented by the updating of organizational management and infrastructure in support of the University's core activities of teaching, research, extension, culture, and the arts. This policy also includes programs and actions

aimed at the personal development and health care of staff, as well as strengthening relationships with organizations that affect the university's operations. The institutional objectives of the management dimension are:

- Ensure high-quality university management;
- Expand the visibility and presence of the University at national and international levels;
- Strengthen supplementary bodies and the multicampus structure;
- Consolidate culture, arts, and literature within the university environment;
- Strengthen policies promoting sports, health, leisure, well-being, and quality of life;
- Promote innovation and entrepreneurship;
- Strengthen internationalization;
- Develop interdisciplinarity in institutional projects;
- Promote social inclusion and respect for diversity;
- Consolidate environmental sustainability practices.

3.5.5 GOVERNANÇA

To support the previously described dimensions, UFSC created the governance area, which is subdivided into seven resources: People; Planning; Monitoring and Evaluation; Structure; Information Technology; Communication; and Budget. The institutional objectives of the governance dimension are:

- Improve qualification and training policies;
- Provide, maintain, and monitor the workforce and working conditions;
- Strengthen governance policies and the professionalization of management;
- Promote democratic and participatory management;
- Strengthen transparency;
- Promote the monitoring and evaluation of activities carried out;
- Ensure adequate infrastructure for UFSC's activities;
- Promote the expansion and consolidation of the University;
- Guarantee information technology infrastructure and equipment suitable for the University's activities;
- Enhance digital governance by promoting the provision of digital services and social participation through digital means;
- Improve communication in all its forms;
- Develop transparent, efficient, and strategically aligned budget management;
- Increase the acquisition of budgetary and extra-budgetary financial resources.

4 THE TECHNOLOGICAL CENTER OF JOINVILLE AT UFSC

4.1 HISTORY OF THE TECHNOLOGICAL CENTER OF JOINVILLE

UFSC's participation in the Support Program for the Restructuring and Expansion Plan of Brazilian Federal Universities (Reuni) in 2008 enabled the significant expansion of new programs and student slots. With resources from this program, UFSC created and established in 2009 three new campuses: Araranguá, Curitibanos, and Joinville. The Joinville Campus was inaugurated on August 4, 2009, and operated until December 2011 in the facilities of the University of the Region of Joinville (UNIVILLE), located in the northern part of the city. Starting in 2012, due to the need for a larger structure, the campus moved to rented buildings in the Santo Antônio neighborhood. On July 10, 2015, the UFSC University Council approved Normative Resolution No. 55/2015/CUn, which officially included the off-campus units in the institution's General Regulations. The Joinville Campus was then structured as a University Unit called the Joinville Center, housing the Department of Mobility Engineering. This department was created to carry out teaching, research, and extension activities and to train professionals, both at the bachelor's and engineering levels, with high technical and managerial competence. Its focus is on developing technical systems in the vehicular field (automotive, metro, railway, maritime, river, aerospace, and mechatronics) and studying scenarios and projects to solve infrastructure, operation, maintenance, and management problems in transport systems. Over time, other knowledge areas were expected to be integrated into the Joinville Campus to meet environmental, social, economic, human, urban planning, information, and fundamental sciences needs (physics, chemistry, biology, and mathematics).

In 2018, the campus relocated to new facilities within the Perini Industrial Park (Figure 1), located in the Northern Industrial Zone of Joinville. The Joinville Campus is now organized as the Technological Center of Joinville (CTJ), which develops teaching, research, and extension activities aimed at training highly competent technical and managerial professionals. Its focus remains on developing technical systems in the vehicular field (automotive, metro, railway, maritime, river, aerospace) and on studying scenarios and projects to solve issues related to infrastructure, operation, and maintenance of transport systems. The CTJ represents an initiative to foster the production and dissemination of knowledge in mobility-related engineering, both in vehicular contexts and in transport infrastructure and logistics. Currently, seven engineering programs and one interdisciplinary program are offered at CTJ:

- Aerospace Engineering
- Automotive Engineering
- Railway and Metro Engineering
- Mechatronics Engineering
- Naval Engineering
- Civil Infrastructure Engineering
- Transport and Logistics Engineering
- Interdisciplinary Program in Science and Technology

The construction of the permanent campus began on land donated by the Government of the State of Santa Catarina and the Municipality of Joinville, located at km 51/52 of the BR-101 highway, in the southern region of Joinville. The project was structured in accordance with the recommendations of the Simplified Environmental Study carried out by UFSC, as the area was classified as environmentally sensitive. Work teams were organized into seven knowledge fields: archaeology, fauna, flora, geology, geotechnics and geomorphology, hydrology, socioeconomics, and general coordination of implementation. The study was designed to serve as a reference for similar environmentally sensitive areas. For the continuation of construction and implementation, UFSC awaits the allocation of federal funds.

Figure 1 – Image of Block U at the Joinville Campus.

Source: Institutional Communication.

4.2 INFRASTRUCTURE

The infrastructure is distributed across three buildings designed in an exclusive area for the University, named Block U, Block C, and Block L:

Block U – houses the following facilities: classrooms, faculty offices, auditoriums, computer laboratories, the department, the Tutorial Education Program (PET), research and extension laboratories, library (Figure 2a), undergraduate and graduate offices and their coordinations, student assistance, administrative sectors, and the campus administration. The total area is 7,476.22 m².

Block C – includes: the University Restaurant, cafeterias and copy center, student lounge, student union offices, athletic association, male and female locker rooms, cafeteria for outsourced companies and a room for their representatives, as well as a covered bicycle rack with 120 spaces. The total area is 772.42 m².

Block L – houses most of the teaching, research, and extension laboratories (Figure 2b), the junior enterprise, and the workspace for student competition teams. The total area is 2,340.49 m².

Fluid-Structure Laboratory Building – hosts a multi-user laboratory, equipped with a wind tunnel and a circulating water channel.

The U, C, and L Blocks are interconnected by a 200-meter-long walkway. The campus area also includes 906 illuminated parking spaces, an area designated for a vehicle testing track, a multipurpose sports court, and a student lounge area.

Figure 2 – Image of (a) the library in Block U and (b) the laboratory in Block L.

(a) (b)

Source: Institutional Communication.

4.2.1 FACILITIES AND ACCESS TO VIRTUAL SYSTEMS

The IT network at the Joinville Campus is connected to the Florianópolis Campus via fiber optic cable. The connection between the main campus building and the teaching laboratories building is also established through fiber optics. Across the entire campus, network points are available to enable access for computers, printers, VoIP phones, and other devices. Wireless access is also available. Classrooms and auditoriums are equipped with computers and multimedia resources as standard. The institution provides a significant number of computers for administrative use and for faculty, as well as computers available for student use in laboratories. Faculty offices and administrative spaces are equipped with computers, printers, and scanners. Since all devices are network-connected, they provide direct access to the internet and to systems such as Moodle, the academic management system, and the library system. At CTJ, Moodle (www.moodle.ufsc.br) is used by faculty and students at different levels. Moodle (moodle.org) is a course management system designed to support three main aspects of the teaching-learning process:

- Content management: organization and availability of materials for students within the context of courses and classes.
- User interaction: tools for interaction between students and faculty, such as forums, chat, instant messaging, etc.
- Monitoring and assessment: submission, tracking, and evaluation of assignments, quizzes, surveys, grade assignment, grade calculation, etc.

Undergraduate academic management is carried out through the CAGR system (www.cagr.ufsc.br), which integrates student academic life information with course offerings at CTJ. Students also have access to IT resources at the Joinville Campus Sectoral Library and in the five computer laboratories available at CTJ.

4.2.2 PHYSICAL SPACE

The physical areas available for faculty, students, and third parties are as follows:

• *Faculty offices for full-time professors*
All permanent professors in the program have an office, with rooms shared by 2, 3, or 4 professors located in Block U.

• *Workspace for program coordination and academic services*
The program coordination has an office in Block U for student assistance and academic services.

• *Classrooms*
CTJ has: 5 classrooms with capacity for 25 students (50 m²), Figure 3; 17 classrooms for 50 students (68 m²); 2 classrooms for 45 students (61 m²); 2 classrooms for 100 students (127 m²); 1 drawing classroom for 64 students (127 m²); 1 auditorium (U216) with 212 seats (283 m²); 2 auditoriums (U217a and U217b) with 195 seats each (295 m²).

Figure 3 – Image of the classroom.

Source: Institutional Communication.

• *Computer laboratories*
There are 5 air-conditioned computer labs with multimedia projectors available for teaching and student use: 1 lab for 51 students (U201 – 127 m²); 1 lab for 27 students (U203 – 68 m²); 1 lab for 30 students (U205 – 68 m²); 1 lab for 28 students (U212 – 87 m²); 1 lab for 13 students (U214 – 60 m²), which is exclusively for student use.

In compliance with accessibility legislation (Federal Constitution/1988, Articles 205, 206, and 208; ABNT NBR 9.050/2004; Law No. 10.098/2000; Decrees No. 5.296/2004, No. 6.949/2009, No. 7.611/2011; and Ordinance No. 3.284/2003), most classrooms and laboratories are located on the ground floor. For those on the second floor, access is also provided via ramps with handrails.

4.2.3 STUDENT ACCESS TO COMPUTER EQUIPMENT

Students have access to computer equipment with four computers and two terminals for the bibliographic database located in the Joinville Campus Sectoral Library (Figure 4a), as well as in the five computer laboratories at CTJ (Figure 4b). Access during class hours and tutoring hours is available for student use.

Figure 4 – Image of (a) the library in Block U and (b) the computer laboratory.

Source: Institutional Communication.

4.3 LIBRARY

The references for the basic and supplementary bibliography of the courses are available at the unit's library, and all items are registered as University property. Access to the physical

collection is provided through the Pergamum system (pergamum.ufsc.br), which meets students' needs for bibliographic consultation. Virtual access to e-books is available through the Library Portal (portal.bu.ufsc.br) via the University's VPN, with no limits on time or hours of consultation. The electronic book database includes the following collections: Atheneu, Directory of Open Access Books (DOAB), e-BOOK Collection (EBSCOhost), IEEE Xplore Digital Library, Open Research Library, USP Open Books Portal, SciELO Books, Springer, Wiley Online Library, and Zahar.

In addition, the academic community has access to databases containing standards, technical articles, dissertations, theses, and other electronic books from various fields of knowledge, through platforms such as: ABNT, African Newspapers, Literary History Database and Digital Literature Library, Capes Theses Database, BASE, Brazilian Digital Library of Theses and Dissertations (BDTD), Directory of Open Access Journals (DOAJ), EBSCO Host – Scientific Publications, EUMED.NET Virtual Encyclopedia, LIVIVO, Livre: Portal for Open Access Journals on the Internet, Networked Digital Library of Theses and Dissertations (NDLTD), OASISBR – Brazilian Portal for Open Access to Scientific Information, Open Access Theses and Dissertations (OATD), Open Grey, Catarina Portal (Santa Catarina literary works), Capes Journal Portal, UFSC Journal Portal, Public Domain Portal, Portcom, PQDT Open, ProQuest Dissertations & Theses Global (PQDT Global), BHL SciELO Network, UFSC Institutional Repository, SciELO, SPELL, and UpToDate.

The library also provides access to the Capes Journal Portal (www-periodicos-capes-gov-br.ezl.periodicos.capes.gov.br), which includes full-text access to more than 45,000 international and national publications, as well as references and abstracts of academic works, standards, patents, theses, and dissertations in all fields of knowledge. Access is guaranteed to University users through VPN and CAFe (Federated Academic Community) with institutional login.

5 CONTEXTUALIZATION AND JUSTIFICATION OF THE PROGRAM

The vehicle fleet in Brazil surpassed 100 million units in 2018, including cars, trucks, buses, and motorcycles, according to IBGE data (IBGE, 2021). This sector represents about 20% of the national GDP and generates 1.5 million direct and indirect jobs (Souza & Bragagnolo, 2019). However, the market still demands new products and services, as well as improved transport, traffic, and logistics infrastructures to support the different systems. The national automotive industry follows global trends in the adoption of electric and hybrid vehicles, connectivity, automation, and Industry 4.0 manufacturing processes. Despite this, Brazil still faces a shortage of engineers compared to developed countries (Lins et al., 2014). The Federal Government, through the REUNI program, set out to increase the efficiency of the national education system, expand course offerings, and adjust higher education to the country's needs. Actions to overcome labor market deficiencies are therefore of great importance within this program.

It was within this context that the Department of Mobility Engineering at the Technological Center of Joinville was established, along with the Automotive Engineering Program. UFSC's recognition and the decision to expand activities into the interior of Santa Catarina sparked community interest while challenging the institution to design innovative projects aligned with Brazil's realities and global trends. The program is strategically located in Joinville/Araquari, near automotive companies and in proximity to major industries in the metropolitan region of Curitiba. This positioning allows it to meet local demands and create joint opportunities, consistent with the University's mission. For example, in 2014, the German company BMW inaugurated its first factory in Latin America, in Araquari, with an investment of about R$1 billion. Likewise, in 2013, the South Korean company LS Mtron, a tractor manufacturer, established operations in Garuva, with an investment of about R$87 million. These developments had a direct impact on the entire chain of goods and services in the region, generating a strong demand for specialized engineering professionals to support product development and innovation.

5.1 PROGRAM OBJECTIVE

The Bachelor's Degree in Automotive Engineering is awarded to students who successfully complete the required coursework in the basic engineering cycle at CTJ, the program-specific subjects, and elective/optional courses, in addition to meeting the minimum workload of complementary and extension activities as defined by Resolution CNE/CES No. 2 of June 18, 2007 (Ministry of Education, 2007). The program focuses on the integrated development of vehicles and automotive systems, emphasizing the principles and fundamentals that underpin engineering solutions applied in these systems. Throughout the program, automotive product development is addressed as a set of knowledge areas, including informational, conceptual, preliminary, and detailed product design, as well as aspects of manufacturing, usage, maintenance, withdrawal, and disposal of automotive products.

To this end, the curriculum integrates subjects in the following fields of knowledge:

- Product design and development

- Product manufacturing
- Automotive technical systems
- Electrical and electronic systems applied to vehicles
- Thermal systems
- Product engineering

The program provides a broad understanding of the basic concepts of automotive systems, rooted in mechanical engineering but complemented by electrical, electronic, and mechatronic engineering, in order to align with current and future automotive systems development. In this structure, the basic cycle and transversal disciplines shared across the seven engineering programs and one interdisciplinary bachelor's program are designed to build competencies in core engineering fundamentals: calculus, statistics, physics, technical drawing, universal design, programming, chemistry, materials science, project fundamentals, ethics, ergonomics, economics, and environmental impact, among others, complemented by technical competencies. 5th and 6th semesters: focused on transversal subjects in mechanical and vehicular engineering, including introductory program-specific courses. From the 7th semester onwards: program-specific and elective subjects are introduced. Electives may be chosen from Automotive Engineering or from other undergraduate and graduate programs, subject to approval by the program's collegiate body.

Additionally, students engage in extension activities integrated into curricular units related to their training and specialization. In the final stage of the program, students must complete a capstone project (thesis) and the mandatory internship.

6 PROFILE AND COMPETENCIES OF THE GRADUATE

According to the National Council of Education Resolution No. 2, of April 24, 2019 (Ministry of Education, 2019), which establishes the national curricular guidelines for undergraduate engineering programs, the training of engineers aims to provide professionals with the knowledge required to perform the following competencies and profile:

I – Have a holistic and humanistic vision, being critical, reflective, creative, cooperative, ethical, and with strong technical training;
II – Be able to research, develop, adapt, and apply new technologies with an innovative and entrepreneurial approach;
III – Be capable of recognizing user needs and formulating, analyzing, and solving engineering problems creatively;
IV – Adopt multidisciplinary and transdisciplinary perspectives in practice;
V – Consider global, political, economic, social, environmental, cultural, safety, and occupational health aspects;
VI – Act with impartiality and commitment to social responsibility and sustainable development.

From the program's first training cycle, the development of knowledge, competencies, skills, and attitudes of a general nature is pursued, as defined in Article 4 of Resolution No. 2, April 24, 2019 (Ministry of Education, 2019):

I – Formulate and design desirable engineering solutions, analyzing and understanding users and their context:
a) Be able to use appropriate techniques for observing, understanding, recording, and analyzing user needs and their social, cultural, legal, environmental, and economic contexts;
b) Broadly and systematically formulate engineering problems, considering the user and context, designing creative solutions, and using appropriate techniques.

II – Analyze and understand physical and chemical phenomena through symbolic, physical, and other models, verified and validated through experimentation:
a) Be able to model phenomena and physical and chemical systems using mathematical, statistical, computational, and simulation tools, among others;
b) Predict system outcomes through models;
c) Design experiments that generate real results for the behavior of phenomena and systems under study;
d) Verify and validate models using appropriate techniques.

III – Design, project, and analyze systems, products (goods and services), components, or processes:
a) Be able to design creative, desirable, and technically and economically viable solutions within their application contexts;
b) Design and determine the constructive and operational parameters for engineering solutions;
c) Apply management concepts to plan, supervise, develop, and coordinate engineering projects and services.

IV – Implement, supervise, and control engineering solutions:
a) Apply management concepts to plan, supervise, develop, and coordinate the implementation of engineering solutions;
b) Be able to manage both the workforce and physical resources in terms of materials and information;
c) Develop global awareness within organizations;
d) Design and develop new entrepreneurial structures and innovative solutions to problems;
e) Perform critical-reflective evaluation of the social, legal, economic, and environmental impacts of engineering solutions.

V – Communicate effectively in written, oral, and graphic forms:
a) Be able to express oneself adequately in Portuguese or in another language, including through the consistent use of digital information and communication technologies (ICTs), staying updated on available methods and technologies.

VI – Work in and lead multidisciplinary teams:
a) Be able to interact with different cultures, working in teams either in person or remotely, facilitating collective construction;
b) Act collaboratively, ethically, and professionally in multidisciplinary teams, both locally and in networks;
c) Manage projects and lead proactively and collaboratively, defining strategies and building consensus in groups;
d) Recognize and coexist with sociocultural differences at different levels in all contexts of activity (global/local);

e) Prepare to lead enterprises in all aspects of production, finance, human resources, and market.

VII – Know and apply legislation and regulations in the exercise of the profession, with ethics:
a) Be able to understand legislation, ethics, and professional responsibility and evaluate the impacts of engineering activities on society and the environment.
b) Always act in compliance with legislation and with ethics in all activities, ensuring this also occurs in the contexts where one is engaged.

VIII – Learn autonomously and deal with complex situations and contexts, keeping up to date with advances in science, technology, and innovation challenges:
a) Be able to adopt an investigative and autonomous attitude aimed at continuous learning, the production of new knowledge, and the development of new technologies.
b) Learn how to learn.

Throughout the program, students are expected to develop specific knowledge required for the planning, design, assembly, production control, and maintenance of vehicles intended for transporting cargo, people, and information. Within this scope, the curriculum focuses on Automotive Engineering, reinforcing knowledge in five core areas:

- Mechanical/Automotive Design
- Mechanical/Automotive Manufacturing
- Electrical/Electronic Systems
- Management
- Fluid and Thermal Systems

To support this formation, the program also develops abilities related to the following systems:
Powertrain systems: understanding principles of operation for thermal and electric engines.
Structural systems: understanding the components that shape the vehicle body, including supports for other systems and directional elements. Navigation systems: recognizing the devices required for vehicle operation and maintenance. Embedded systems: identifying electronics and computing elements associated with proper functioning of individual systems and the vehicle as a whole. Accessory systems: grasping concepts tied to comfort, aesthetics, safety, and vehicle ergonomics.

The profile of graduates from the Bachelor of Automotive Engineering program is oriented toward the ability to:

- Act, evaluate, implement, manage, and maintain systems involving technological knowledge across the different stages of automotive development and updating, including components and systems.
- Plan, execute, and monitor projects of automotive systems, subsystems, and auto parts.
- Identify possibilities and limitations, proposing solutions to problems identified during the various phases of automotive product development, applying existing scientific and technological knowledge.
- Design support systems for the manufacturing of automotive systems, subsystems, and parts.
- Plan, execute, and analyze vehicle tests.
- Manage and elaborate processes for design, manufacturing, and assembly of systems and components.

- Apply current norms and legislation in Automotive Engineering that impact industrial practice.
- Analyze the impacts of safety, collective health, environmental issues, and business processes within companies and the supply chain.
- Prepare and interpret technical documentation, allocating resources and analyzing project implementation costs.

- Propose solutions for improving functionality, operation, development, and production of automotive components and systems.
- Conduct economic and environmental feasibility analysis of processes and mechanical manufacturing.

7 ADMISSION METHODS

Admission to undergraduate programs at the CTJ takes place through the annual selection process (entrance exam and SISU) with semester entry. There is also the possibility of admission through a return of graduates, or internal and external transfer, with the number of places defined in specific Calls for Applications. The enrollment system, after the selection process, is defined by Resolution 017/CUn/97 (University Council, 1997) of UFSC, which establishes the regulations for its undergraduate programs.

8 TEACHING STRATEGIES

The undergraduate programs at the Center for Mobility Engineering follow a pedagogical plan with a specific format, based on the following principles:

- Strengthening the student's autonomy in their academic training;
- Organization of courses by knowledge clusters/areas;
- Organization of subjects with cross-cutting themes;
- Implementation of an integrative project course at the end of the program, applying knowledge from the automotive field with emphasis on project-based learning;
- Elective course selection based on students' aspirations and qualifications, approved through a multi-criteria evaluation considering the interest of the student, the institution, and society;
- Number of seats for each engineering program defined every semester by the institution, based on pre-established studies;
- Availability of non-mandatory internships to complement academic knowledge;
- Vertical and horizontal integration of professors;
- Final year project (Thesis/Capstone) aligned with the student's chosen area of training;
- Participation in extension activities as part of the mandatory curricular extension requirement;
- Offering of complementary activities that allow students to integrate teaching, research, and extension.

The curriculum structure of the Bachelor's in Automotive Engineering is organized in three progressive blocks:

1. Basic sciences: courses common to all students in the Department of Mobility Engineering, focusing on mathematics, physics, chemistry, computing, and introductory engineering subjects. These courses promote integration and interdisciplinarity across scientific, technical, social, environmental, and ethical training.

2. Transversal content: courses shared with the mechanical engineering area, adding intermediate technical knowledge and expanding the student's engineering foundations.

3. Specialized automotive content: specific courses in automotive engineering, complemented by electives, curricular internship, and the final graduation project.

The weekly course load is less than 25 hours per week, as required by Resolution 017/CUn/97 (University Council, 1997), and the program's total workload is over 3,600 hours, complying with the minimum defined by MEC Resolution Nº 2/2007 (Ministry of Education, 2007). To graduate, students must: Complete all mandatory courses, Earn the minimum credits in electives, Fulfill the minimum hours in complementary activities, Fulfill the minimum hours in extension projects, and Successfully defend their Final Graduation Project.

Mandatory courses (Table 2) include the compulsory internship, which must be carried out in the student's field of study. This structure allows students to actively engage in teaching, research, and extension, giving them a broad and integrated vision of engineering, aligned with the competencies defined in the Graduate Profile and Competencies section. The curricular flow is represented in Figure 5.

Table 1 – Content to be completed for curriculum integration.

COURSE LOAD

	CREDITS	Class Hours	Hours	PERCENTAGE
Mandatory Courses	197	3546	2955	80,5%
Extension (Course)	13	234	195	5,3%
Extension (Curricular Unit)	12	216	180	4,9%
Electives	5	90	75	2,0%
Complementary Activities	6	108	90	2,4%
Mandatory Internship	12	216	180	4,9%
TOTAL	245	4410	3675	100,0

8.1 ASSESSMENT AND REMEDIATION

At the beginning of each academic semester, every instructor provides students with a course syllabus, in which the course content, teaching strategies, and assessment methods are specified. The forms of assessment vary by course and may include exams, assignments, reports, application exercises, and others. The weighting of grades from these assessments is also detailed in the syllabus. The approval criteria are defined by Resolution 17/CUn/1997 (University Council, 1997). To pass a course, students must: Achieve a minimum attendance rate of 75%; Obtain a minimum grade of 6.0. Grades are awarded in increments no smaller than 0.5. For students who meet the attendance requirement but

achieve an average grade between 3.0 and 5.5, there is an opportunity to take a remedial evaluation. In such cases, the final grade is calculated as the average of the partial grades and the remedial evaluation grade.

9 CURRICULUM MATRIX

Table 2 – Curriculum matrix of the Automotive Engineering course.

SEMESTER 1

COURSE CODE		THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE
EMB5001	Differential and Integral Calculus I	2	2		4	
EMB5005	Analytic Geometry	2	2		4	
EMB5055	Graphic Representation	2	1		3	
EMB5063	Science, Technology and Society	1	1		2	
EMB5379	Introduction to Automotive Engineering	1	1		2	
EMB5036	Chemistry for Engineering	2	2		4	
	Total	**10**	**9**	**0**	**19**	

SEMESTER 2

COURSE CODE		THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE	
EMB5062	Communication and Expression	1	1		2		
EMB5007	Linear Algebra	2	2		4	EMB5005	
EMB5012	Drawing and Geometric Modeling	2	1		3	EMB5055	
EMB5029	Differential and Integral Calculus II	2	2		4	EMB5001	
EMB5648	Programming I	2	2		4		
EMB5048	Physics I	2	2		4		
EMB5332	Introduction to Automotive Engineering Project	1	1		2	EMB5379	ou EMB5351
	Total	**12**	**11**	**0**	**23**		

SEMESTER 3

COURSE CODE			THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE		
EMB5011	Statics		2	2		4	EMB5048		
EMB5016	Numerical Calculus		2	2		4	EMB5005	EMB5001	EMB5648
EMB5022	Materials Science		2	2		4	EMB5001	EMB5036	
EMB5030	Vector Calculus		2	2		4	EMB5029	EMB5005	
EMB5039	Physics II		2	2		4	EMB5001	EMB5048	
EMB5057	Statistics I		2	2		4	EMB5001		
		Total	**12**	**12**	**0**	**24**			

SEMESTER 4

COURSE CODE			THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE		
EMB5014	Series and Differential Equations		2	2		4	EMB5029	EMB5007	EMB5016
EMB5021	Solid Mechanics I		2	2		4	EMB5011		
EMB5041	Dynamics		2	1		3	EMB5011		
EMB5043	Physics III		2	2		4	EMB5030	EMB5039	
EMB5009	Thermodynamics		2	2		4	EMB5029	EMB5039	
EMB5059	Design Methodology		2	1	1	4	800h/a		
		Total	**12**	**10**	**1**	**23**			

SEMESTER 5

COURSE CODE			THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE	
EMB5061	Metrology		2	1		3	EMB5057	
EMB5102	Manufacturing Processes		2	2		4	EMB5022	
EMB5104	Solid Mechanics II		2	2		4	EMB5021	
EMB5101	Mechanisms		1	1		2	EMB5041	
EMB5017	Fluid Mechanics		2	2		4	EMB5009	EMB5030
EMB5120	Management and Organization		4	0		4	1400h/a	
EMB5108	Electric Circuits		2	2		4	EMB5005	EMB5029
		Total	**15**	**10**	**0**	**25**		

SEMESTER 6

COURSE CODE		THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE		
EMB5316	Vehicle Dynamics	2	2		4	EMB5041		
EMB5064	Environmental Impact Assessment	1	1		2			
EMB5115	Vibrations	2	2		4	EMB5014	EMB5041	
EMB5352	Fracture Mechanics	1	1		2	EMB5104		
EMB5353	Computer-Aided Manufacturing	1	1		2	EMB5102		
EMB5431	Fundamentals of Combustion	2	1		3	EMB5014	EMB5017	
EMB5103	Heat Transfer I	2	2		4	EMB5014	EMB5017	
EMB5961	Engineering Economics	2	1		3	EMB5057	1400h/a	
	Total	**13**	**11**	**0**	**24**			

SEMESTER 7

COURSE CODE		THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE		
EMB5119	Machine Elements	2	2		4	EMB5104	EMB5101	
EMB5117	Introduction to Finite Element Method	2	2		4	EMB5104		
EMB5304	Internal Combustion Engines I	2	2		4	EMB5103	EMB5431	
EMB5056	Ergonomics and Safety	1	1		2			
EMB5341	Materials and Processes for Vehicle Construction I	1	1		2	EMB5102		
EMB5320	Entrepreneurship and Innovation	1	1		2	EMB5961	EMB5059	EMB5120
EMB5327	Hydraulic, Pneumatic Actuation and Brakes	2	1		3	EMB5316		
EMB5392	Heat Treatment Technology Applied to Automotive Components			4	4	EMB5102		
	Total	**11**	**10**	**4**	**25**			

SEMESTER 8

COURSE CODE		THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE		
EMB5303	Vehicle Systems I: Chassis, Suspension, and Steering	2	2		4	EMB5119	EMB5316	
EMB5324	Mold and Die Design for the Automotive Industry	1	1		2	EMB5012	EMB5102	
EMB5342	Welding Processes for Automotive Engineering	2	2		4	EMB5022	EMB5108	
EMB5356	Materials and Processes for Vehicle Construction II	1	1		2	EMB5022		
EMB5044	Final Project Planning	1	1		2	2592h/a		
EMB5329	Transmissions	2	1		3	EMB5119		
EMB5350	Statistical Quality Control	2	2		4	EMB5057		
EMB5100	Entrepreneurship and Innovation Project			4	4	EMB5320		
EMB5370	Complementary Activities				(6)	2.400h/a		
	Total	**11**	**10**	**4**	**25**			

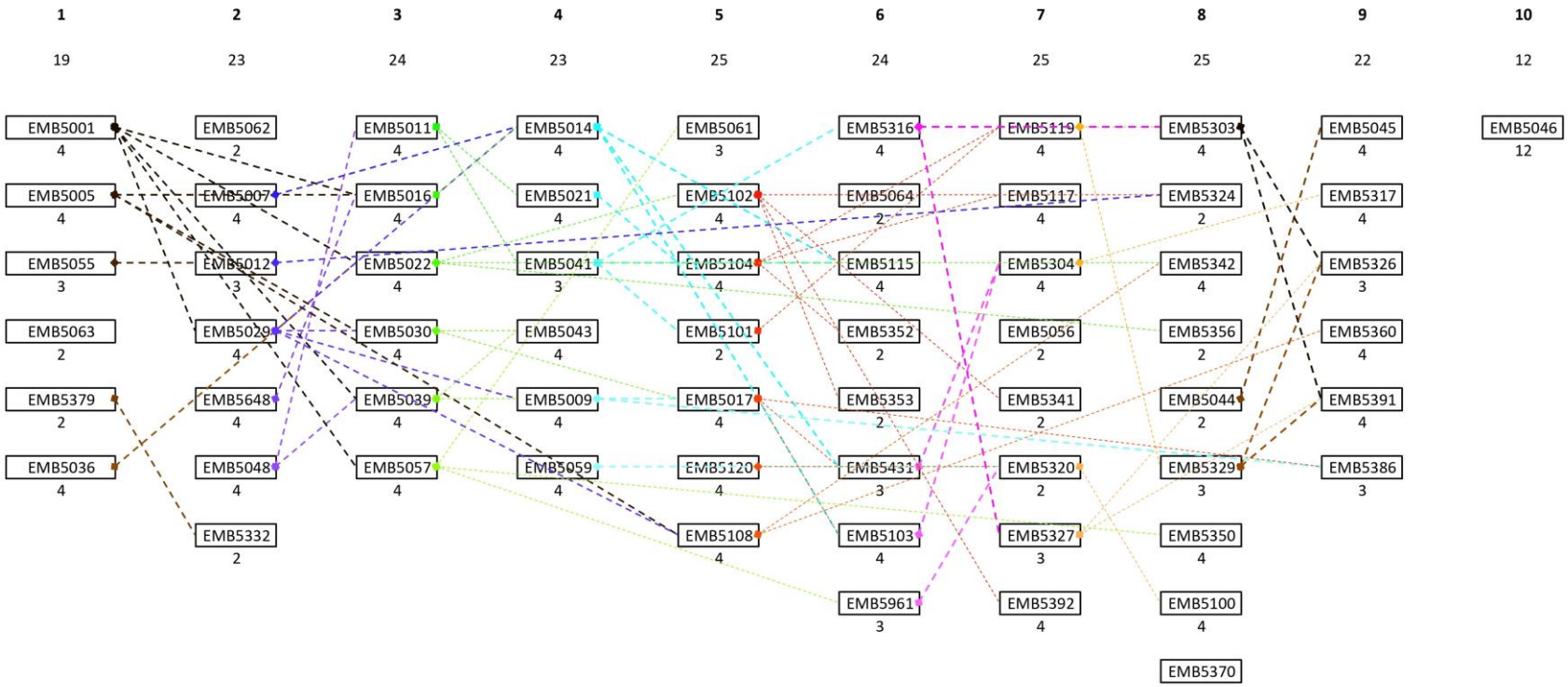
SEMESTER 9

COURSE CODE		THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE		
EMB5045	Final Project	0	4		4	EMB5044		
EMB5317	Vehicle Aerodynamics	2	2		4	EMB5304		
EMB5326	Vehicle Product Development	0	3		3	EMB5303	EMB5329	EMB5327 ou (EMB5303 e EMB5313)
EMB5360	Introduction to Electric Vehicles	2	2		4	EMB5108		
EMB5386	Refrigeration and Air Conditioning	3	0		3	EMB5009	EMB5017	
EMB5391	Transforming Society with Vehicles			4	4	EMB5303	EMB5329	EMB5327 ou (EMB5303 e EMB5313)
	Total	**7**	**11**	**4**	**22**			

SEMESTER 10

COURSE CODE		THEORETICAL (credits)	PRACTICAL (credits)	EXTENSION (credits)	TOTAL	PREREQUISITE
EMB5046	Mandatory Curricular Internship				12	3496h/a
	Total	**0**	**0**	**0**	**12**	

Figure 5 – Illustration of the curriculum in PPC2025.



9.1 PREREQUISITES

As part of the strategy to consolidate competencies and skills by strengthening knowledge in the basic areas of exact sciences and engineering, courses are conditioned by prerequisites, which are either courses from earlier semesters and/or a minimum approved workload that students must have completed and passed beforehand. The prerequisites are presented in the curriculum matrix in Table 2.

9.2 COURSE EQUIVALENCE

The courses included in the 2016 PPC (Pedagogical Project of the Course) that are not common to this current Pedagogical Project will no longer be offered with the semester-by-semester implementation of this PPC. The equivalence between the two curriculum structures is presented in Table 3 and Table 4.

Table 3 – Equivalence Matrix between PPC2016 and PPC2025 Courses.

Code (PPC2016)	Course Title (PPC2016)	Equivalent Course (PPC2025)
EMB5034	Physics I	EMB5048
EMB5035	Graphic Representation	EMB5055
EMB5037	Communication and Expression	EMB5062
EMB5038	Science, Technology and Society	EMB5063
EMB5351	Introduction to Automotive Engineering	EMB5379
EMB5006	Technological Chemistry	EMB5036
EMB5600	Programming I	EMB5648
EMB5010	Statistics and Probability	EMB5057
EMB5032	Environmental Impact Assessment	EMB5064
EMB5033	Metrology	EMB5061
EMB5105	Mechanisms	EMB5101
EMB5026	Ergonomics and Safety	EMB5056
EMB5042	Product Design Methodology	EMB5059
EMB5110	Machine Elements	EMB5119
EMB5355	Materials and Processes for Vehicle Construction I	EMB5341
EMB5313	Vehicle Systems II: Transmission and Brakes	EMB5327 e EMB5329
EMB5325	Welding Processes	EMB5342
EMB5357	Automotive Quality Management	EMB5067

Table 4 – Equivalence Matrix of Courses from PPC2025 to PPC2016

Code (PPC2025)	Course Title (PPC2025)	Equivalent Course (PPC2016)
EMB5055	Graphic Representation	EMB5035
EMB5063	Science, Technology and Society	EMB5038
EMB5379	Introduction to Automotive Engineering	EMB5351
EMB5036	Chemistry for Engineering	EMB5006

Code (PPC2025)	Course Title (PPC2025)	Equivalent Course (PPC2016)
EMB5062	Communication and Expression	EMB5037
EMB5648	Programming I	EMB5600
EMB5048	Physics I	EMB5034
EMB5057	Statistics I	EMB5010
EMB5061	Metrology	EMB5033
EMB5101	Mechanisms	EMB5105
EMB5064	Environmental Impact Assessment	EMB5032
EMB5110	Machine Elements	EMB5119
EMB5056	Ergonomics and Safety	EMB5026
EMB5341	Materials and Processes for Vehicle Construction I	EMB5355
EMB5327	Hydraulic, Pneumatic Actuators and Brakes	EMB5313 e EMB5047
EMB5342	Welding Processes for Automotive Engineering	EMB5325
EMB5329	Transmissions	EMB5313 e EMB5047
EMB5350	Statistical Quality Control	EMB5385
EMB5067	Quality Management	EMB5357

9.3 ELECTIVE COURSES

The elective courses are freely chosen by students, who may opt for different areas of specialization within Automotive Engineering or select courses from other programs offered at UFSC, both undergraduate and postgraduate (Stricto Sensu) levels (EMB5387 and EMB5388). Students must complete the minimum course load established for this activity (Table 1), 5 credits (90 contact hours). The course load of elective courses is within the limit determined by Article 15 of Resolution 17/CUn/1997 (University Council, 1997). The elective courses of the Automotive Engineering program are described in the section “Elective Courses – Syllabi” at the end of this document.

9.4 FINAL YEAR PROJECT (TCC)

The Final Year Project (Capstone Project) is governed by internal regulations, available at https://joinville.ufsc.br/tcc/. It is an activity that the student must carry out individually, under the supervision of a professor from the Center, applying the competencies acquired throughout the program, in accordance with Resolution No. 2/2019 of the National Education Council (Ministry of Education, 2019). The TCC is divided into two courses: one dedicated to TCC Planning, which introduces writing standards and research methodologies, and another focused on carrying out the project activities themselves. These courses do not include face-to-face classes. At the end, the student must submit a written version of the project to an examination committee and defend it publicly.

9.5 COMPLEMENTARY ACTIVITIES

The pedagogical project of the program includes, in its curriculum, a mandatory workload of 6 credits (108 hours/class) dedicated to complementary activities (Table 1). These are

activities chosen by the students and accounted for by the number of hours completed. At the CTJ, different initiatives are developed to encourage students to engage in complementary activities aligned with the graduate profile, as well as to contribute to their technical, scientific, and social development. These activities may include participation in technical lectures, extension courses, technical visits, scientific initiation projects, and non-mandatory internships, among others. Attendance as a participant (only as a listener) will be credited as a complementary activity, while active involvement and leadership in extension courses may also generate extra extension hours that can, in some cases, be counted toward the complementary activities requirement. The validation of Complementary Activities is carried out by the program coordination and regulated through a specific form updated by the NDE and the Collegiate, which is available on the program's website automotiva.ufsc.br. In accordance with MEC Resolution No. 2 of 2007 (Ministry of Education, 2007), the combined workload of complementary activities and the mandatory internship is less than 20% of the total course workload.

9.6 INTERNSHIP

The Mandatory Curricular Internship is a supervised educational activity developed in the workplace, included in the pedagogical project of the program as an integral part of the student's academic pathway. Therefore, it is a mandatory academic activity for all students, carried out in a single stage through the course Mandatory Curricular Internship, with a total workload of 216 class hours (12 credits). It is conducted in accordance with the specific regulations of the Joinville Center, available on the program's website automotiva.ufsc.br (Centro Tecnológico de Joinville, 2017), and in compliance with the minimum workload of 160 hours established by MEC Resolution No. 2 of 2019 (Ministry of Education, 2019). According to Article 7 of Normative Resolution No. 73/2016/CUn, it is possible to recognize professional competencies acquired in formal employment as equivalent to the mandatory internship. The validation process is the same: the student must enroll in the Mandatory Internship course, but does not sign the internship agreement. Instead, the student must present proof of professional work when submitting the final report. The weekly workload of the internship may be 30 hours for students enrolled in other courses, or 40 hours for those not enrolled in in-person classes (except for the Final Graduation Project – TCC). Students may also complete non-mandatory internships, according to CTJ regulations, with a maximum workload of 30 hours per week. All non-mandatory internships must be formalized through an Internship Agreement registered in the UFSC system, and they may also be counted toward Complementary Activities validation.

10 PRACTICAL AND LABORATORY ACTIVITIES

The Automotive Engineering program has the infrastructure of several teaching, research, and extension laboratories to conduct demonstrative classes, experimental practices, and to support research (scientific initiation) and extension activities. The laboratories are supervised by faculty members of the Campus, operate under their own rules of use and safety, and receive funding from the Center for the acquisition of equipment and supplies, according to budget availability. They also follow the University's waste collection and treatment policy, managing everything from storage to proper disposal. Regarding accessibility, many laboratories are located on the ground floor of the buildings, and those situated on the second floor can also be accessed via ramps with handrails.

The areas related to programming, design, modeling, and development of numerical tools are hosted in computer laboratories equipped with software such as CAD (Autodesk AutoCAD, SketchUp Make, SolidEdge, SolidWorks, etc.), different programming languages (Gfortran 95, Java, Python), and specific programs used in the automotive and mechanical industries, such as Finite Element and CFD tools (Abaqus, CFD Studio, Ansys, AVL, etc.), data acquisition software (LabView and Arduino IDE), and numerical simulation software (Matlab, Scilab, etc.). Currently, the facilities (Table 5) include:

Table 5 – CTJ Computer Laboratories.

Computer Laboratory 01 (U201)	• Room size: 127,54m² • 51 computers (Intel Core i5 and Intel Core i7) • 1 multimedia projector • Wireless microphone kit • Amplified speaker
Computer Laboratory 02 (U203)	• Room size: 68m² • 27 computers (Intel Core i5) • 1 multimedia projector
Computer Laboratory 03 (U205)	• Room size: 68m² • 30 computers (Intel Core i5) • 1 multimedia projector
Computer Laboratory 04 (U212)	• Room size: 87m • 28 computers (Intel Core i5) • 1 multimedia projector

Throughout the program, students attend courses that include practical or demonstrative classes in both basic sciences such as physics and chemistry, as well as in specific Automotive Engineering subjects. These activities promote the practical application of techniques and the integration of theoretical knowledge within a professional context.

The teaching laboratories for these courses are:

- *Multidisciplinary Laboratory (Chemistry/Physics)*

Located in Block L (Room 407), Figure 6a, this lab has an area of 94.96 m² with 07 benches. It is equipped with analytical and semi-analytical balances, ovens, muffle furnace, refrigerator, conductivity meter, fume hood, distiller, deionizer, magnetic stirrers, multimeters, standard weights, and chemical supplies such as sodium hydroxide, aluminum sulfate, iron sulfate, zinc sulfate, copper sulfate, nitric acid, among others. For Physics teaching, the lab

also includes experimental kits in mechanics, thermodynamics, electrostatics, and electrodynamics/electromagnetism. This space is dedicated to experiments in basic courses, introducing students to an integrated perspective between theory and the representation of physical and chemical phenomena.

- *Electrical Circuits and Electronics Laboratory*

Located in Block L (Room 413), this lab has 61.12 m² with 06 benches. It is equipped with function generators, oscilloscopes, DC power supplies, ET-2082C multimeters, RLC-510 escort icel meters, and didactic kits for electronics experimentation. In this environment, students apply their knowledge of electrical and electronic systems, assembling circuits to strengthen their understanding of the fundamental principles of automotive embedded systems.

- *Manufacturing Laboratory*

Located in Block L (Room 406), Figure 6b, this lab has an area of 123.90 m² and is equipped with conventional lathes, a Romi D600 machining center, surface and cylindrical grinders, a universal milling machine, an Arbug 320C 500-170 polymer injection molding machine, and a hydraulic tube bender, along with a wide range of mechanical tools to support machining and assembly. The laboratory is used in manufacturing-related courses to introduce students to the mechanical production sector. It also supports University extension and research projects, enabling the fabrication and testing of prototypes.

Figure 6 – Images of the laboratories. (a) Multidisciplinary Laboratory and (b) Manufacturing Laboratory.

(a) (b)

Source: Institutional Communication.

- *Metrology and Industrial Quality Laboratory (METEQ)*

Located in Block L, Room 410, with 71.03m², it is equipped with instruments and devices such as analog external micrometers, digital calipers, ceramic gauge block sets, mechanical dial indicators and probes, universal angle protractors (goniometer type), VB300 optical profile projector, height gauge, analytical balance, weight set from 1–20,000g, portable roughness tester, precision linear level, portable digital anemometer, digital sound level meter, digital tachometer, coordinate measuring machine, among other measuring devices. The laboratory applies these instruments, following the concepts of the Metrology discipline, to train students in dimensional evaluation of components and calibration of measuring devices, providing a foundation for work in manufacturing engineering and design activities.

- *Welding Technology Laboratory (LTS)*

Located in Block L, Room 427A (Figure 7a), with 40m², it is equipped with multiprocess welding sources, TIG and ER, electromagnetic induction equipment, oxyacetylene welding, data acquisition system, microscope, hydraulic press, fume hood, and metallographic weld characterizers. The course Welding Processes for Automotive Engineering uses this space to conduct experiments related to automotive manufacturing processes by welding, complementing the practices of the Manufacturing Laboratory. The laboratory has also supported extracurricular student activities, such as the fabrication of competition vehicles for extension projects.

- *Vehicle Systems Laboratory*

Located in Block L, Room 404, with 50m², it contains a light vehicle (disassembled), automotive components on display (steering, transmissions, brakes, suspension, engine, etc.), an automotive lift, scales, and general tools. This lab supports courses in mechanical design, enabling students to visualize and understand the operation of vehicle components and mechanisms. It is also used for instrumentation before carrying out vehicle tests in the Vehicle Systems and Vehicle Product Development courses.

In addition to these laboratories directly linked to the curriculum, the Center also provides other facilities related to research, extension, and teaching, where students may participate as interns, scholarship holders, or volunteers, applying their course knowledge. Examples include: the Innovation and Product Development Laboratory (Figure 7b), the Computer-Aided Manufacturing Laboratory (GPCAM), the Acoustics and Vibrations Laboratory (LAV), the Software/Hardware Integration Laboratory (LISHA), the Automation and Control Systems Laboratory (LASC), the Renewable Energy Group Laboratory (GREEN), the Transport Phenomena Laboratory, the Internal Combustion Engines Laboratory, the Materials Characterization Laboratory, the Subsonic Wind Tunnel (AEOLUS), the Experimental Solid Mechanics Laboratory (LMSE), the Vehicle Refrigeration Laboratory (ReVe), among others from related programs.

Figure 7 – Images of laboratories: (a) Welding Technology Laboratory and (b) Innovation and Product Development Laboratory.

(a) (b)

Source: Institutional Communication.

As mentioned earlier in this document, the Automotive Engineering course has, as part of its support infrastructure, an asphalt-paved area for vehicle testing (Figure 8), where competition vehicles and instrumented cars are tested in subjects related to vehicle design.

Figure 8 – Illustration of acoustic measurement carried out on the test track.

11 CURRICULAR EXTENSION POLICY

Based on the guidelines for extension in Higher Education, Resolution No. 7 of the CNE (National Education Council, 2018), this pedagogical project incorporates actions aimed directly at the community outside the University. The purpose of this curricularization of extension is to promote the exchange of knowledge between the institution—represented by the students of the Automotive Engineering program—and society, committed to addressing current and future challenges. These activities require students to participate in programs, projects, courses and workshops, events, service provision, and extension courses throughout the program, being required to fulfill the minimum workload in extension and to pass the specific extension courses (Figure 9).

The difference between these activities and Complementary Activities is that, in extension, the student acts as the executor of actions for society ("interventions that directly involve external communities of higher education institutions and are linked to the student's education" (Ministry of Education, 2018)), whereas in Complementary Activities they may take a passive role (attending courses and lectures) or engage in academic work, such as scientific initiation, and professional work, such as non-mandatory internships. The goals and indicators pursued in the curricularization of extension in the program are:

- To create interaction between the academic community and society, with indicators such as the number of people, companies, and projects reached within the organization of extension programs and courses;

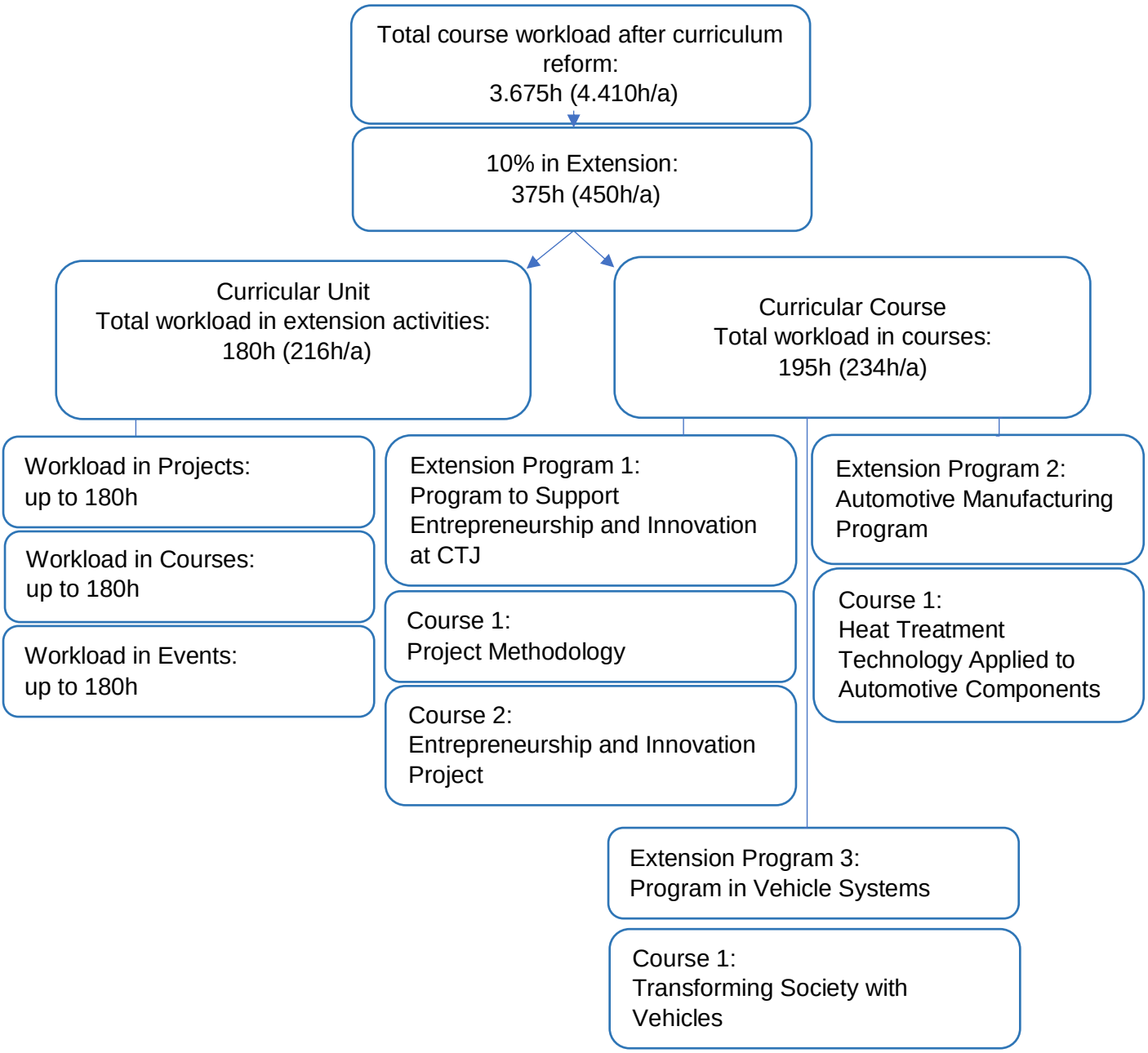
- To produce changes within the institution and in sectors of society through the construction, application, and transfer of knowledge, with indicators such as the number of events, courses/workshops, training sessions, and the delivery of products and services to the external community;

- To promote integration between teaching/extension/research, evaluated through indicators such as the number of patents, technical articles, and bibliographic references made available to the community.

The physical spaces required for extension activities are the computer labs and the teaching, research, and extension laboratories at the Joinville Campus (joinville.ufsc.br/laboratorio-de-ensino-pesquisa-e-extensao/), in addition to the infrastructure available to competition teams (joinville.ufsc.br/equipes-competicao/). In these spaces, activities of undergraduate and graduate teaching, research experiments, and extension work are shared, aiming at the inseparability of the three areas: teaching, research, and extension.

With resources from external projects and the UFSC Office of Extension, there are also rooms equipped specifically for extension activities, such as the Active Methodologies Room (U202), the coworking space for extension projects, and the video recording and editing room. These are equipped to enable different extension curricular units, including workbenches, 3D printers, digital whiteboards, and computers.

Figure 9 - Schematic diagram detailing the extension workload.



11.1 THEMATIC AXES IN THE EXTENSION PROGRAM

The Automotive Engineering course has three thematic axes for the extension courses registered in SIGPEX (Integrated System for the Management of Research and Extension Projects) as extension programs, which are: a) Support Program for Entrepreneurship and Innovation at CTJ (5 extension credits), b) Automotive Manufacturing Program (4 extension credits), and c) Vehicle Systems Program (4 extension credits). Each of these axes addresses a specific aspect of engineering: the first is directed toward the area of management, the second focuses on the productive activities of products in the manufacturing environment, and the last emphasizes the functional and developmental

aspects of vehicle products. The extension courses related to the aforementioned programs are described in Table 6.

Table 6 – List of Extension Courses.

Code	Objective	Total Hours	Extension Hours	Target Audience	Program
EMB5059 Project Methodology	Identify the aspects of a systemic and integrated view of the product and service development process. Identify and understand the various phases involved in the development of a product/service project. Learn the main product/service development tools used by companies. Identify the interrelationships among the different stages of development. Apply the main tools of product/service project development in a project involving the community.	4	1	Microentrepreneurs	Support Program for Entrepreneurship and Innovation at CTJ
EMB5100 Entrepreneurship and Innovation Project	This course aims to work on the integration of the entrepreneurship axis courses, in an integrated manner, so that students develop the conception of a product or service, based on the pillars of a sustainable organization (social, environmental, and financial), with the objective of meeting a societal need. The course seeks to encourage students to develop the interrelationship of the competencies being acquired throughout their training, which will contribute to applicability in the context of technological areas and society.	4	4	Microentrepreneurs	
EMB5392 Heat Treatment Technology Applied to Automotive Components	The main objective of this course is to stimulate the production and application of knowledge, within the metal-mechanical cluster of Joinville, in solving real problems related to the practice and optimization of heat treatments for different purposes in the automotive industry.	4	4	Industries of the Metal-Mechanical Cluster	Automotive Manufacturing Program
EMB5391 Transforming Society with Vehicles	Train students to understand the concept of extension, develop material for the production and dissemination of best practices, and contribute to building a more critical and socially aware society through educational and informative extension actions. Students apply the knowledge and tools acquired in the course to meet the needs of society, aiming to improve quality of life and vehicle safety.	4	4	Society	Vehicle Systems Program

a) Support Program for Entrepreneurship and Innovation at CTJ

This program encompasses the Support Program for Entrepreneurship and Innovation at CTJ, which is a set of courses included in the curriculum of the program. The courses that comprise the extension activities are: EMB5059 – Project Methodology (1 credit of extension workload) and EMB5100 – Project to Undertake and Innovate (4 credits of extension workload). Thus, the Entrepreneurship Axis results in a total of 5 extension credits in curricular courses, whose purpose is to develop and enhance the skills and competencies required in engineering training. Among the expected skills and competencies are a holistic vision, innovative and entrepreneurial practice, as well as creativity in solving problems in the field. The context of the Support Program for Entrepreneurship and Innovation at CTJ is based on the process of developing new business ideas, products, or services. It begins with a macro stage of pre-development, which seeks to define the products/services to be launched in the coming years. Next comes the project planning stage (defining the path to launch the product to the market); product development (starting with understanding customer needs and desires, up to product engineering); production preparation until the product launch. Finally, the post-development stage follows, focusing on monitoring the product in the market and within the company. The program works with organizations that need support or seek improvements in the process of developing new ideas and their insertion into the market, providing studies and technical feasibility analyses. Since the activities may involve the entire supply chain, students act broadly within the community and in integration with different CTJ programs.

In an innovation ecosystem, collaboration among various agents (entrepreneurs, investors, accelerators, incubators, universities, government, sectoral organizations, community) allows for combining different stories and perspectives to propose solutions to real problems. These solutions are the result of unique combinations that could not be achieved individually. This program seeks to contribute to these solutions and to enhance student training quality, reduce dropout rates, and promote academic success. In the context of extension activities carried out in the courses of this program, students will engage in identifying demands, generating business ideas (business plans), and presenting proposals and solutions to society, through direct contact with stakeholders (micro-entrepreneurs, private and public institutions, small family-owned businesses, etc.) and/or through events organized for disseminating new business ventures. With this type of work, an important communication channel is opened with small entrepreneurs to assist in managing their businesses, seeking sustainability and improving work methods. As a result for the community, the better performance of individual businesses will foster job creation, improve local income, and provide access to information and knowledge that would not normally be available free of charge.

b) Automotive Manufacturing Program

In the pedagogical proposal of the Automotive Engineering program, the axis that encompasses the different areas of mechanical manufacturing consists of courses focused on the study of materials science and engineering (metallic and non-metallic) and manufacturing processes such as: casting, mechanical forming, machining, powder metallurgy and sintering, polymer processing, in addition to the introduction to CNC machining programming and simulation and the integration of CAD/CAM/CNC, NC systems. The inclusion of the Automotive Engineering program at UFSC within the metal-mechanical hub of Joinville and the region opens up significant professional opportunities for future

graduates, which can be stimulated through the production and application of knowledge developed in the classroom, in direct connection with real problems in the productive sector. The purpose of the Automotive Manufacturing Extension Program is primarily to stimulate the production and application of knowledge, within the metal-mechanical hub of Joinville, in solving real problems related to the practice of heat treatments of metallic, ferrous, and non-ferrous components for various purposes in the automotive industry.

Within the UFSC Automotive Engineering curriculum, topics related to the theory and practice of heat treatment are addressed in a general and superficial manner, resulting in a significant knowledge gap that becomes evident when students engage in extracurricular activities that demand these skills while still in their undergraduate studies. An example of this are the students who participate in competition teams, where they are challenged to design, manufacture, and validate components that form part of different vehicle systems, providing an effective practice for ensuring student engagement with the program. Those who do not participate in such extracurricular projects graduate without experiencing this important engineering practice. The extension course Technology of Heat Treatments Applied to Automotive Components, part of the Automotive Manufacturing Program, seeks both to fill these knowledge gaps during the training of automotive engineers—specifically in areas directed at the treatment of parts through volumetric and/or surface heat treatments—and to foster student interaction with different industries in Joinville that provide specialized services in these areas. Heat treatment is an essential stage in the production chain of mechanical components, now regulated by certification entities, to ensure the quality of treated products, especially those destined for automotive industry applications. Thus, the scope of this proposal reinforces student involvement in solving real problems related to qualifying work procedures aimed at recognition and competitiveness of small- and medium-sized companies within the local production cluster that provide heat treatment services to automotive companies.

Through the strategies and methodologies adopted in the course, a collaborative space will be created for producing technical works, involving both students and industry professionals. These efforts will lead to improvements in work procedures for process route optimization, resource efficiency, quality control of treated products, and the digital management of information from local industries. The goal here is to disseminate manufacturing concepts to local companies, promoting better performance and reducing environmental, economic, and social impacts in the organization of production processes. For the implementation of this course's pedagogical proposal, some local companies—already engaged with the University through technical visits, curricular internships, and previously completed final projects, or through the development of heat treatment solutions applicable to competition vehicles—have expressed interest in hosting the factory and laboratory environments to be used in the course. TupyTec, located in the northern industrial district of Joinville, about 5 km (approximately 8 minutes) from UFSC, is one of the companies that has shown interest in creating and executing this extension course. Other heat treatment companies in the city, such as Tecnotêmpera and Termotêmpera, are also supportive of integration with the University.

c) Vehicle Systems Program

The Vehicle Systems Extension Program, associated with the course EMB5391 – Transforming Society with Vehicles in Automotive Engineering, develops a learning environment focused on automotive-related topics (cars, trucks, buses, tractors, etc.). The

target audience includes laypeople interested in learning more about vehicles, as well as mechanical specialists who lack specific knowledge in automotive engineering. The main topics addressed are vehicle safety, vehicle operation, and predictive and corrective maintenance. As part of the extension activities, educational materials are provided in the form of courses, booklets, manuals, brochures, and educational guides, as well as technical content using 3D images of automotive parts and virtual simulators, all made available to those interested in the field. The goal is to disseminate appropriate practices in the use of motor vehicles and to support community learning. This program consolidates accurate and coherent information about automotive mechanics. Materials are produced and disseminated (in person) during community events or in spaces with high public circulation.

The physical infrastructure that supports the program is located in the Vehicle Systems Laboratory (U404), which includes automotive components, mechanical tools, an automotive lift, and a light vehicle. The lab's webpage (labsistemasveiculares.ufsc.br) is also used as a platform for disseminating content created by students. The program's main objectives are to increase public interest in topics that encourage better vehicle use and safety, focusing especially on accident prevention and reducing fatalities. During community-based extension activities, situations and problems are identified that require interventions to improve quality of life and preserve life. For example, reducing deaths and injuries caused by improper use or lack of vehicle maintenance.

In this course, events and training sessions are organized in partnership with public institutions (such as the Department of Motor Vehicles, highway patrol, municipalities, etc.) and private organizations that need support in promoting best practices related to vehicles (e.g., agriculture, which uses tractors and self-propelled vehicles like harvesters and sprayers). Students engage with the community to understand extension goals, define and generate technical solutions, and later disseminate appropriate solutions and procedures tailored to community needs. By experiencing applied engineering work aimed at solving practical societal issues, the program seeks to reduce student dropout and retention rates, while improving comprehension of technical concepts and reinforcing the purpose of what is taught in the program.

For the local community, the program provides access to free information and training designed to generate improvements in:

- Social/Economic aspects: by expanding opportunities in vehicle-related occupations, such as professional drivers or delivery workers.
- Environmental aspects: through proper vehicle maintenance and use, thereby reducing emissions and improper disposal of pollutants.
- Functional aspects: by preventing or minimizing vehicle breakdowns during operation.
- Safety aspects: by raising awareness about identifying risk situations in vehicles to prevent accidents.

11.2 EXTENSION CURRICULAR UNITS

In addition to courses with an extension component, part of the workload (Table 1) is developed by students through extension curricular units of free choice throughout the program. These curricular units are defined by the Universidade Federal de Santa Catarina (2020) as extension activities in projects, events, and courses, organized as follows:

I – Extension Actions I – Projects

II – Extension Actions II – Events
III – Extension Actions III – Courses

These activities are coordinated by faculty members of the Center, who regularly open calls for scholarship holders and volunteers. Students in the Automotive Engineering program may also participate in projects offered by other programs, thus broadening their experiences and interacting with professionals from diverse fields. Examples of ongoing projects include:

- Podcast + Ciência – Aims to disseminate science beyond academia by using podcasts as the main communication medium. The focus of the activities in this program is on topics covered by the Department of Mobility Engineering courses.
- UFSC/Joinville Science and Technology Space – A hub composed of several projects and initiatives designed to strengthen the interaction between the university and society, contributing to the popularization of science and technology. The space features racing simulators (Figure 10a), 3D printers, a plasma globe, scale models (such as energy generation, the city of Joinville, and satellites), and didactic kits for solar/wind energy and LEGO NXT/EV3 robotics, to engage elementary and high school students.
- Pré-UFSC Joinville: Preparatory Course for Higher Education Entrance Exams – Aims to provide high-quality tutoring so that underprivileged youth gain access to higher education, particularly public institutions, thereby helping reduce social inequality.
- Strategic Games as a Support Tool in Engineering Education IV – Designed to stimulate interest in engineering among regional school students through educational games. The program currently has a collection of seven printed games (Figure 10b), which are distributed to public school students in Joinville during workshops at the Science and Technology Space (ECT).
- Technical Advisory and Training in Management Systems for Measurement – Establishes mechanisms for training and technical advisory services aimed at improving industrial quality through extension activities focused on disseminating knowledge and skills in statistics, metrology, and industrial quality.
- Among others.

Figure 10 – ECT Environment. (a) Racing simulators. (b) Printed games.

(a) (b)

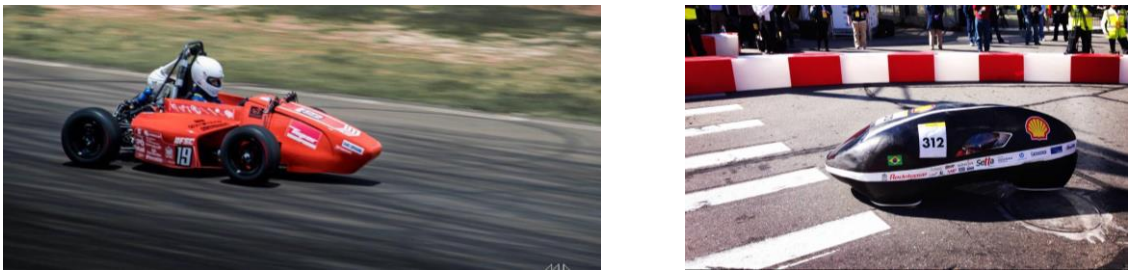
Source: ECT.

Moreover, UFSC maintains vehicle competition teams, supported with resources from the University, in which students can participate and count the extension workload in these

projects. Each competition team has its own assembly and storage space at the CTJ, in addition to access to laboratories for project development with computers, construction/assembly using machining and welding equipment, and vehicle measurement/testing. For the latter, CTJ provides an area to be used as a vehicle testing track. The teams related to the course include:

- Fórmula CEM – The Formula SAE (FSAE) aims to provide engineering students with the dissemination and exchange of techniques and knowledge, through their application in the design of a single-seater vehicle (Figure 11a), powered by combustion or electric engines, from conception through detailed design, manufacturing, and testing stages.
- CTJ-Baja – Through the Baja SAE program, students engage in a real case of developing an off-road vehicle, from conception, detailed design, construction, to field testing.
- Vehicles for Energy Efficiency Marathons – Development of prototype vehicles (Figure 11b), both electric and combustion-powered, to participate in the University Energy Efficiency Marathons and the Shell Eco-Marathon, the latter held annually by SHELL in the United States of America and in Brazil.

Figure 11 – Illustration of competition vehicles: (a) Formula CEM and (b) EFICEM.



(a) (b)

Source: Institutional Communication.

The validation of the extension workload carried out in projects chosen by the students will be performed by the course coordination, based on the hours registered by the student in UFSC's records system (SIGPEX) and the classification of the project as part of the curricularization of extension.

12 NATIONAL LEGISLATION FOR HIGHER EDUCATION

12.1 NATIONAL GUIDELINES FOR HUMAN RIGHTS EDUCATION

As provided in Opinion CNE/CP No. 8, of 03/06/2012, which gave rise to Resolution CNE/CP No. 1, of 05/30/2012 (CNE, 2012), the PPC of the Bachelor's Degree in Automotive Engineering addresses the theme of human rights in a transversal manner, being emphasized in the courses Introduction to Automotive Engineering (EMB5379) and Science, Technology, and Society (EMB5063).

12.2 NATIONAL GUIDELINES FOR THE EDUCATION OF ETHNIC-RACIAL RELATIONS AND FOR THE TEACHING OF AFRO-BRAZILIAN AND AFRICAN HISTORY AND CULTURE

According to Resolution CNE/CP No. 1/2004 (CNE, 2004), based on Opinion CNE/CP No. 3/2004, which establishes the National Curriculum Guidelines for the Education of Ethnic-Racial Relations and for the Teaching of Afro-Brazilian and African History and Culture, the subject is addressed in the Bachelor's Degree in Automotive Engineering through the course Science, Technology, and Society (EMB5063).

12.3 ENVIRONMENTAL EDUCATION

In accordance with Law No. 9795/1999 and Decree No. 4281/2002 (Brazil, 2002), from the Presidency of the Republic, which address environmental education policies, the content is worked on transversally in the program and is specifically emphasized in the course Environmental Impact Assessment (EMB5032).

12.4 GUIDELINES ON FIRE AND DISASTER PREVENTION AND RESPONSE MEASURES

As established in Law No. 13425, of March 30, 2017 (DIÁRIO OFICIAL DA UNIÃO, 2017), from the Presidency of the Republic, which sets out general guidelines on fire and disaster prevention and response measures in establishments, buildings, and public gathering areas, the content required by Article 8 of this law is addressed in the course Introduction to Automotive Engineering (EMB5379).

12.5 BRAZILIAN SIGN LANGUAGE – LIBRAS

The course Brazilian Sign Language – Libras I (LSB7244) is included as an elective in the Bachelor's Degree in Automotive Engineering, in accordance with Decree No. 5.626, of December 22, 2005 (Brazil, 2005), from the Presidency of the Republic, which regulates Brazilian Sign Language.

12.6 UNIVERSAL DESIGN

In accordance with Opinion CNE/CES No. 948/2019, approved by the order of March 23, 2021, the curriculum of the program addresses the theme of Universal Design within the course Project Methodology (EMB5059).

13 EVALUATION OF THE PEDAGOGICAL PROJECT

In order to maintain the quality of the three main pillars of the University—Teaching, Research, and Extension—the Course Collegiate works with diagnostic and evaluation policies for the Bachelor's Degree in Automotive Engineering, which involve four main actions:

- Gather information on the status of the program;
- Identify conditions and demands imposed by new legislation;
- Prepare reports on the need for curriculum reform; and
- Evaluate suggestions for modifications and updates to the curriculum.

The periodicity of the program's diagnostic and evaluation is defined by the Course Collegiate and the Núcleo Docente Estruturante (NDE, Structuring Teaching Core), as well as by the different committees that form working groups for the execution of specific tasks and actions required in the course's diagnostic and evaluation. As part of a continuous improvement process, the program's self-assessment aims to diagnose the current status through data analysis from surveys. This allows the identification of weaknesses and strengths, contributing to the development of actions that improve teaching quality. A research process is conducted with students from the CTJ, based on guidelines established by the Comissão Própria de Avaliação (CPA, Internal Evaluation Committee). The evaluation is carried out at the end of the academic semester, and the compiled data is made available to stakeholders.

The goal is to conduct evaluations that reflect not only students' perspectives but also those of the faculty and administrative staff, including the program coordinator's assessment. The NDE also contributes to the formulation, revision, implementation, and ongoing development of the Pedagogical Project, with responsibilities that include:

- Reviewing and presenting proposals for curriculum adjustments when necessary;
- Monitoring pedagogical practices developed throughout the semester;
- Proposing interdisciplinary and complementary activities to be carried out by the program;
- Suggesting ways to encourage and develop research and extension initiatives aligned with undergraduate needs and the program's field of knowledge.

13.1 ROLE OF THE STRUCTURING TEACHING CORE (NDE)

The NDE of the Bachelor's in Automotive Engineering program was created on September 18, 2013 by Ordinance 091/2013/DAC/CJ (Academic Directorate, 2013). It was established to develop the following activities:

- Draft the pedagogical project of the program, defining its conception and foundations;
- Establish the graduate's professional profile;
- Evaluate and update the pedagogical project, guided by the National Curriculum Guidelines;
- Conduct curriculum restructuring efforts for approval by the program's Collegiate, when necessary;
- Supervise the evaluation and monitoring methods defined by the Collegiate;
- Analyze and evaluate course syllabi and their articulation with the pedagogical project;

- Promote horizontal and vertical integration of the program, respecting the axes established by the pedagogical project.

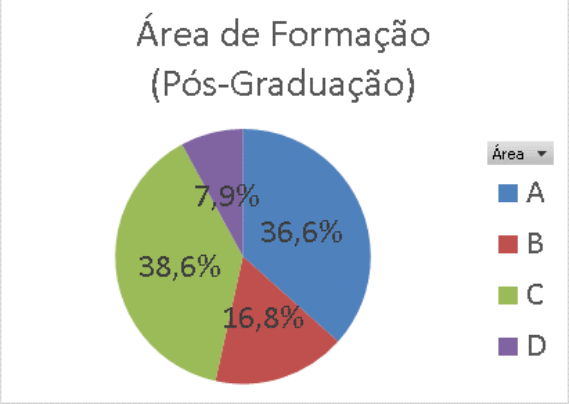
The NDE is composed of at least five faculty members from the program, with periodic and partial renewal of its members to ensure continuity of actions, as recommended by CONAES (National Higher Education Evaluation Commission, 2010).

14 FACULTY

The faculty of the Joinville Technology Center (CTJ) is composed of approximately 100 professors, of whom 98% hold doctoral degrees and 2% hold master's degrees (data from August 2021). These degrees were obtained from both national and internationally recognized institutions, and the faculty members bring significant experience in Teaching, Research, and Extension. Many of these professors teach in the Automotive Engineering program, either in shared courses with other engineering programs or in program-specific courses. In addition, they coordinate research and extension projects across a wide range of themes within the exact sciences, in which students of the program actively participate. The distribution of faculty members according to their postgraduate training areas is illustrated in Figure 12, divided into the following categories:

Code	Area
A	Exact and Earth Sciences; Engineering II (Mining, Materials and Metallurgical, Chemical, Nuclear Engineering); Biological Sciences; Applied Social Sciences; Humanities; Linguistics, Languages and Arts.
B	Engineering I (Civil, Sanitary, Transportation Engineering).
C	Engineering III (Mechanical, Production, Naval and Ocean Engineering, Aerospace Engineering).
D	Engineering IV (Electrical, Biomedical Engineering).

Figure 12 – Postgraduate training areas of the faculty.



The complete list of professors can be found on the program's official webpage: automotiva.ufsc.br.

15 STUDENT SUPPORT AND WELCOMING

At UFSC, the process of forming well-rounded individuals is guided by a strong social commitment, especially toward students who face economic challenges in maintaining their studies. At the same time, many students—regardless of financial situation—experience difficulties in keeping up with their academic programs for various reasons, even after gaining admission through competitive selection processes. This context has led the University to develop both financial support programs (through scholarships and assistance grants) and pedagogical support programs. In addition, UFSC provides psychological support, which is sought in different situations, whether related to health or learning difficulties. Another important practice is the monitoring of alumni, not only for lifelong learning initiatives but also to gather feedback on how well their training meets professional and societal needs.

15.1 STUDENT SUPPORT PROGRAMS

The student support activities aim to address needs not fully covered by the academic curriculum, through financial assistance, pedagogical guidance, or psychological care. Even students who were admitted in good standing may require this additional support throughout their studies. At the Joinville Campus, student support is structured around three main university bodies:

- PRAE (Dean of Student Affairs)
  Oversees and evaluates student assistance programs across all campuses, offering financial aid policies (scholarships, housing, food subsidies, transportation, etc.), and supporting equity in academic permanence.
- PROGRAD (Dean of Undergraduate Education)
  Responsible for promoting undergraduate education and ensuring that students have the necessary conditions to exercise citizenship and professional practice, in line with the National Education Guidelines and Bases and the university's Institutional Pedagogical Project. The PIAPE (Institutional Program for Pedagogical Support to Students) is coordinated by PROGRAD and has a local branch at Joinville Campus.
- SAAD (Office for Affirmative Action and Diversity)
  Develops awareness campaigns focused on minority rights, accessibility, health, violence prevention, and inclusion.

To implement these programs effectively, the Joinville Campus relies on an interdisciplinary team composed of: Two social workers, one educational psychologist, one sign language interpreter, one administrative assistant, one staff member with higher education in pedagogy/education, officially appointed to serve as the local PIAPE coordinator.

15.1.1 STUDENT ASSISTANCE

The financial support benefits for student retention are accessed through proof of family income, either during admission (via validation of self-declaration of income) or by creating a PRAE Registry. This registry is a technical-operational tool used to analyze and interpret the

social situation of UFSC undergraduate students. At the Joinville Campus, the PRAE-related benefits available to students are as follows:

Ongoing Support Benefits

- University Restaurant (RU) and RU Fee Waiver

Provides balanced, nutritious, and varied meals to promote student health and ensure university retention. Access is through two modalities: subsidized payment of R$1.50 or complete exemption for students with a valid PRAE registry and family income up to 1.5 minimum wages per capita.

- Housing Assistance

A monthly grant of R$250 (2021 value) to help cover rental expenses, improving living conditions and supporting student permanence.

- Student Grant (Bolsa Estudantil UFSC)

Established by Normative Resolution 32/CUn/2013, this program provides R$754.84/month (2021) to undergraduate students in proven socioeconomic vulnerability, ensuring financial conditions for academic continuity.

- Childcare Assistance (Auxílio Creche)

Aimed at students with children up to 6 years old who did not secure a spot in public daycare centers. Benefit values (2021):

  - Up to R$448.00 (partial)
  - Up to R$771.00 (full)

- Student Assistance Program for Indigenous and Quilombola Students (PAIQ)

A monthly grant of R$900.00 for students from Indigenous and Quilombola backgrounds with an approved PRAE registry, provided they are not already beneficiaries of the MEC Grant or the UFSC Student Grant.

Occasional Support Benefits

- Support for Presentation of Academic Work

Financial aid for undergraduate students presenting research at national or international scientific-academic events, fostering undergraduate research dissemination.

- Support for Collective Participation in Events

Assistance for groups of students attending academic, scientific, institutional, or technical events, where multiple participants from UFSC are involved.

- Support for Organizing Academic Events

Financial backing for undergraduate students to organize academic events within their programs.

In addition to addressing material vulnerabilities, the Student Assistance sector also provides help for other student needs, aiming to ensure a positive academic experience in Joinville. This includes social, psychological, and academic support initiatives that complement financial aid.

15.1.2 WELCOMING INCOMING STUDENTS

Welcome visits and follow-up visits are conducted with freshman cohorts (first-semester undergraduate students of each program). Depending on the interest of each program, the Student Assistance team uses one class session, during the first or second week of the semester, to welcome new students. During this meeting, the team introduces itself, presents the benefits available through the Student Assistance sector, and engages in dialogue about several aspects related to learning processes, student life, university entry, expectations, potential, and challenges. Also, depending on each program's coordination, after the first

round of exams in the initial semester, the educational psychology service uses half of a class session (45 minutes) to revisit the freshmen and assess how their integration into UFSC Joinville is progressing. This session includes conversations about their first weeks at the university, initial evaluations, mental health, and academic life, while also reinforcing the services available to support their adaptation to the new environment.

15.1.3 EDUCATIONAL FOLLOW-UP FOR STUDENTS WITH GRANTS

Each year, the Student Assistance sector reviews undergraduate students receiving Student Grants who are experiencing difficulties in the basic cycle and/or at risk of failing to meet the conditions required for renewal of the benefit. After discussing these cases with the respective program coordinations, each grant holder is offered an appointment with a Student Assistance professional and/or the Program Coordinator. The goal is to prevent students from losing their grant due to non-compliance with the requirements. The meetings involve discussions about the student's academic reality and reflection on possible strategies to reduce failures and/or overcome difficulties in completing the basic cycle of their program. Additional strategies may also be discussed to address other challenges identified, which can include referrals to services within the campus or the municipal network. The partnership with the Program Coordinations depends on their engagement and interest.

15.2 EDUCATIONAL PSYCHOLOGY

15.2.1 WORKSHOPS AND DISCUSSION CIRCLES IN THE EDUCATIONAL AREA

Semester meetings on topics considered important for/by undergraduate students at CTJ. In groups of up to 20 participants, the educational psychologist proposes discussions on themes related to routine and academic performance. The workshops and circles are held in one or two sessions, each lasting up to two hours.

15.2.2 DIAGNOSTIC INTERVIEWS WITH STUDENTS EXPERIENCING PERFORMANCE DIFFICULTIES

Each year, the Student Assistance sector and Academic Coordination identify undergraduate students with a Cumulative Performance Index below 3.0. All of these students are offered an appointment with the educational psychologist or the academic coordinator. In these meetings, the student's academic situation is discussed, reflecting on possible causes of failures and strategies to resolve observed academic difficulties. Referrals may also be made to campus or municipal services if factors beyond the scope of these sectors are identified.

15.2.3 WORKSHOPS AND DISCUSSION CIRCLES IN THE AREA OF MENTAL HEALTH

Annual meetings on topics considered important for/by undergraduate students at CTJ. In groups of up to 20 participants, the educational psychologist leads discussions on mental health topics and provides information on quality of life and the prevention of psychological illness. The workshops and circles consist of one session lasting up to two hours.

15.2.4 CLINICAL PSYCHOLOGY SERVICES

Brief psychotherapy sessions are offered, conducted by senior-year interns from psychology programs in Joinville, supervised by the psychologist at UFSC Joinville and a professor from their home institution. Undergraduate students (with priority for those registered with PRAE or from public schools) are offered five individual 45-minute sessions, scheduled weekly.

15.2.5 TALKING ABOUT ANXIETY

A project offered each semester to all undergraduate students. Groups consist of up to 10 students, with up to eight sessions of approximately one hour each. During the sessions, the educational psychologist discusses the relationship between anxiety and the academic routine at CTJ-UFSC and introduces cognitive and relaxation techniques for mental health prevention.

15.2.6 SUPPORT AND GUIDANCE FOR VICTIMS OF PREJUDICE AND VIOLENCE

This service is available to any undergraduate student facing issues related to prejudice or violence based on gender, sexual orientation, race, origin, religion, or disability within the university environment. The service is individual, usually conducted by a social worker and a psychologist, lasting about one hour, and may be offered as a one-time or recurring appointment. During the session, the professionals welcome, listen to, and support the student, and may also provide guidance on possible referrals within UFSC and to public authorities.

15.3 ACCESSIBILITY POLICY

All actions related to educational accessibility at UFSC are the responsibility of the Educational Accessibility Coordination Office (CAE), linked to the Office of Undergraduate Studies (PROGRAD). It is the CAE's role to:
I. develop and implement the institutional policy on accessibility and inclusion of students with disabilities at UFSC;
II. promote equal conditions of access to knowledge for students with disabilities;
III. monitor the academic trajectory of undergraduate and graduate students with disabilities, upholding the principle of safeguarding their rights by ensuring equal opportunities so that they may express their potential in terms of personal autonomy and academic performance;
IV. promote accessibility actions within the university community by offering courses and events for the continuing education of administrative staff and faculty in the areas of Special Education, Human Rights, Assistive Technologies, among others;
V. monitor and provide support for the work carried out in the field of Special Education at the University's Laboratory School and at the Child Development Center, ensuring that such work is conducted in accordance with UFSC's educational accessibility policy, and in compliance with national legislation and policy.

At the Joinville campus, the Student Assistance sector works together with Academic Coordination and Course Coordinations to implement accessibility-related actions. Whenever a student with a disability is identified, these three sectors meet with the student to develop a personalized support plan. The Campus also offers online Libras (Brazilian Sign Language) services for deaf students and community members. Initial assistance is provided by a UFSC Libras interpreter who, when necessary, facilitates communication with other campus

departments through video calls. The purpose of these initiatives is to digitally include deaf individuals, ensuring that information about teaching and other campus activities is fully accessible. In addition to Libras services, the Joinville Campus website was developed with high-contrast and readability tests to facilitate access for people with visual impairments.

15.4 COORDINATING OFFICE FOR EVALUATION AND PEDAGOGICAL SUPPORT (CAAP)

The CAAP, recognizing that teaching and learning processes are fundamentally processes of human development, involving complex multidimensional relationships among social subjects, promotes teaching-learning actions, with pedagogical monitoring of students as a central axis. The Tutoring Program and the Institutional Program for Pedagogical Support to Students (PIAPE) are offered universally to all undergraduate students, starting from their admission to UFSC, with the aim of contributing to retention and ensuring equal learning opportunities.

15.4.1 TUTORING PROGRAM

Tutoring is the pedagogical and didactic activity assigned to an undergraduate student, supervised by a professor responsible for a course included in the current curriculum. It requires planning, development, and evaluation to simultaneously foster the professional development of the tutor and of other students enrolled in the same course or in courses with similar syllabi, in line with the tutor's level of knowledge and experience. Tutoring is considered an academic training activity and has two modalities: (i) paid (with scholarships or other allowances) and (ii) voluntary. Only students who have passed the course they intend to tutor, with a grade of 7.0 or higher, and who have sufficient availability can apply. The Tutoring Program is regulated by Normative Resolution No. 53/CUn/2015, dated June 23, 2015.

For student tutors, tutoring offers experiences related to teaching and the deepening of theoretical and practical knowledge of the course. For those receiving tutoring, it provides pedagogical support, helping to reduce retention and dropout rates and improving academic performance. Tutors are responsible for:

- Preparing, together with the supervising professor, the activity plan and schedule;
- Guiding students who request tutoring;
- Offering pedagogical support to students in completing assignments, clarifying doubts, and contributing to the learning process;
- Assisting in preparing teaching and experimental materials, or those needed for practical classes in laboratories;
- Posting availability schedules in the Tutoring Information System and ensuring attendance at scheduled sessions.

15.4.2 INSTITUTIONAL PROGRAM FOR PEDAGOGICAL SUPPORT TO STUDENTS (PIAPE)

According to Normative Resolution No. 133/2019/CUn, PIAPE is a pedagogical strategy to support and guide UFSC undergraduate students, as well as to assist faculty and undergraduate programs in continuously improving educational activities. PIAPE develops support actions to foster student retention and quality of training, providing conditions tailored to learning needs and helping to improve academic performance. It also serves as a training

space for graduate students, through their role as face-to-face tutors, as established by Normative Resolution No. 3/2020/CPG. PIAPE operates in two modalities: Learning Groups and Pedagogical Guidance (OP). Learning Groups consist of educational practices intentionally designed to enhance students' learning processes, especially by supporting them in following course content. Groups are organized by knowledge field, offered in short modules, workshops, lectures, or other educational formats, and are conducted by tutors with training in the relevant area under the supervision of UFSC faculty. Participation is limited and filled in order of registration, with activities announced on the local PIAPE coordination website.

Pedagogical Guidance (OP) focuses on students needing support in managing their academic lives, planning study routines, and developing autonomy and academic competencies. Activities may be group-based (lectures, workshops, discussion groups) or individual, held weekly or biweekly. Guidance is provided by professionals with degrees in Pedagogy or Psychology and postgraduate training in education, supervised by a UFSC staff member with suitable expertise. Local coordinations, designated by the Unit's Directorate or PROGRAD, are responsible for:

- Assessing students' pedagogical support needs;
- Planning activities jointly with supervisors and tutors;
- Monitoring pedagogical and administrative aspects of support;
- Welcoming new students;
- Organizing events such as lectures and workshops;
- Providing direct support to students;
- Periodically evaluating the program's development and results.

Supervisors are UFSC faculty or administrative staff members appointed by Departments or Campus Directorates with a four-hour weekly workload. They must have recognized academic training and educational experience. Tutors provide teaching activities for undergraduates across UFSC's five campuses. They may be graduate students with active enrollment or administrative staff with expertise in the field. Tutors are responsible for:

- Preparing activity plans with supervisors;
- Supporting undergraduates in mastering foundational content;
- Guiding students on study organization (OP);
- Sharing study methods that help with knowledge acquisition (OP);
- Using varied teaching methodologies;
- Interacting through UFSC's Moodle platform if applicable;
- Recording activity plans, reports, and student attendance.

At the Joinville campus, Learning Groups are currently offered in Physics, Programming, and Mathematics (Pre-Calculus and Calculus I). Each has four modules, except Pre-Calculus, which is a single module designed to strengthen reasoning, problem-solving, and mathematical skills for better performance in related subjects. Finally, partnerships are expected between UFSC and municipal/state education departments or other regional institutions to provide professionals (especially in Pedagogy and Psychology) who are not currently available at the Joinville campus, particularly to support Pedagogical Guidance activities.

15.5 STUDENT ORGANIZATION

Another major area of actions directed toward the student body is support for student representation, which involves dialogue and assistance to students and to the different types of student organizations: the Central Directory of Students, Academic Centers, Junior Enterprises and student-run consulting and assistance entities, Tutorial Education Program (PET), University Pastoral Groups, Student Mobility, and UFSC Alumni. This support is carried out through the registration of student representatives—elected by undergraduate students—within UFSC's deliberative bodies, and through the registration and archiving of disciplinary administrative processes related to Resolution CUn/017/1997 (University Council, 1997), which addresses student matters. CTJ students organize annual academic weeks for their courses, bringing lectures by professionals from industries and companies, fostering interaction between students and engineers, and offering courses related to the professional field. They have also periodically organized the National Congress of Mobility Engineering (CONEMB), which gathers companies and industries from the mobility and services sector, along with students from other universities, in an event featuring lectures, round tables, and courses. These spaces create discussion forums on transportation technologies, social and economic needs, and general trends related to the training and competencies required of graduates.

15.6 ALUMNI FOLLOW-UP

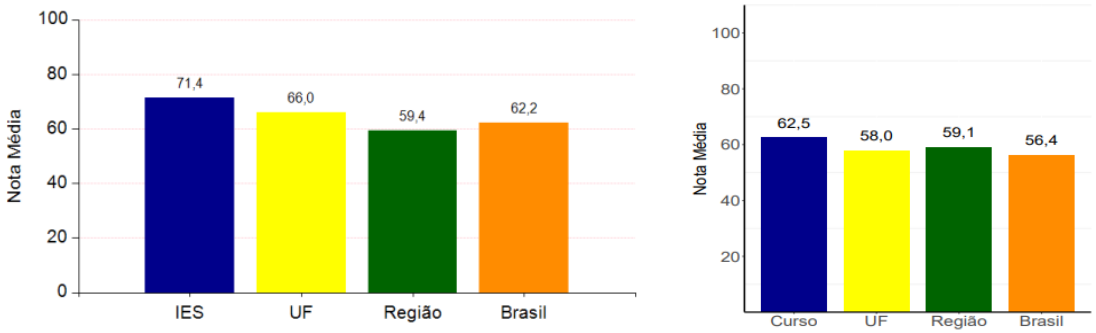
The University tracks graduates through registrations in UFSC's Alumni Portal and contacts with the course coordination, with the goal of understanding professional successes and challenges in entering and remaining in the job market. The information gathered is used by the NDE (Course Structuring Teaching Core) and the Course Collegiate of Automotive Engineering to identify possible updates required in the curriculum. At the same time, it serves as a direct communication channel between the University and alumni, enabling ongoing knowledge exchange and the creation of opportunities for both sides.

16 ENADE EVALUATION

The National Student Performance Exam (ENADE) is one of the pillars of the evaluation system within the National Higher Education Evaluation System (SINAES), established by Law No. 10.861 of April 14, 2004. Along with ENADE, the evaluation of undergraduate programs and institutional evaluation processes form the three key components of SINAES. When combined, the results of these evaluation tools provide an in-depth understanding of how Higher Education Institutions (HEIs) and their programs operate and their overall quality across Brazil. The Automotive Engineering Program at UFSC's Joinville Technology Center participated in ENADE in 2014 and 2017, achieving scores of 5 and 4, respectively. The exams were taken by 62 students in 2014 and 51 students in 2017. In both cases, the exam was applied to graduating students. All results were calculated based on analyses that considered the total number of students summoned and present at the exam, thus extending to the total number of graduating students at the HEI, as detailed in the official course reports available at: ENADE/2014 and ENADE/2017.

The data in these reports reflect the results obtained from the analysis of the students who completed the ENADE. Each exam lasted four hours and, in both years, included components assessing General Education (common to all fields of study) as well as components specific to the mechanical engineering area. The performance of the program's students (Figure 13), according to ENADE reports, showed that the average scores in the general education component of the exam were above the average of students from the region and from Brazil as a whole.

Figure 13 – Comparison of ENADE average scores. (a) 2014 and (b) 2017.



(a) (b)

Source: (INEP, 2015) e (INEP, 2018).

COURSE SYLLABI

17 REQUIRED COURSES – SYLLABI

Course: EMB5001 – Differential and Integral Calculus I
Semester: 1
Workload (credits – class hours): 4 credits – 72h
Prerequisite: None
Syllabus
Concepts of functions of a real variable. Limit and continuity. Derivative. Applications of derivatives. Definite and indefinite integrals – substitution method and integration by parts.

Basic Bibliography

Flemming, D. M.; Gonçalves, M. B. Cálculo A. 6th ed. São Paulo: Pearson Prentice Hall, 2007. ISBN 978-85-76051-15-2.
Guidorizzi, H. L. Um Curso de Cálculo. 5th ed. Rio de Janeiro: Livros Técnicos e Científicos Editora S.A., 2002. v.1. ISBN 978-85-21612-59-9.
Stewart, J. Cálculo. 6th ed. São Paulo: Cengage Learning, 2009. v.1. ISBN 978-85-22106-60-8.

Supplementary Bibliography

Anton, H. A.; Bives, I.; Davis, S. Cálculo. 8th ed. Porto Alegre: Bookman/Artmed Editora S.A., 2007. v.1. ISBN 978-85-60031-63-4.
Demana, F. D.; et al. Pré-cálculo. 7th ed. São Paulo: Pearson Prentice Hall, 2009. ISBN 978-85-88639-37-9.
Leithold, L. O Cálculo com Geometria Analítica. 3rd ed. São Paulo: Harbra Ltda, 1994. v.1. ISBN 978-85-29400-94-5.
Simmons, G. F. Cálculo com Geometria Analítica. São Paulo: Pearson Makron Books, 2008. v.1. ISBN 978-00-74504-11-6.
Thomas, G. B.; et al. Cálculo. 11th ed. São Paulo: Pearson Prentice Hall, 2009. v.1. ISBN 978-85-88639-31-7.

Course: EMB5005 – Analytical Geometry
Semester: 1
Workload (credits – class hours): 4 credits – 72h
Prerequisite: None
Syllabus
Matrices. Determinants. Linear systems. Vector algebra. Study of the line and plane. Plane curves. Surfaces.

Basic Bibliography

Camargo, I.; Boulos, P. Geometria Analítica, um tratamento vetorial. 3rd ed. São Paulo: Pearson, 2005. ISBN 978-85-87918-91-8.
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Boldrini, J. L.; et al. Álgebra Linear. 3rd ed. São Paulo: Harbra, 1980. ISBN 85-294-0202-2.
Kuelkamp, N. Matrizes e Sistemas de Equações Lineares. 2nd revised ed. Florianópolis: Ed. da UFSC, 2007. ISBN 978-85-32803-15-3.
Lehmann, C. H. Geometria Analítica. 9th ed. São Paulo: Globo, 1998. ISBN 978-96-81811-76-1.
Strang, G. Introduction to Linear Algebra. 2nd ed. Wellesley: Cambridge Press, 1993. ISBN 978-09-61408-89-3.

Winterle, P. Vetores e Geometria Analítica. 1st ed. São Paulo: Makron Books, 2000. ISBN 85-346-1109-2.

Course: EMB5055 – Graphic Representation
Semester: 1
Workload (credits – class hours): 3 credits – 54h
Prerequisite: None
Syllabus
Fundamental concepts for preparing and interpreting sketches and technical drawings. Basics of Geometric Drawing. Projective Drawing. Drawing standards (ABNT). Dimensioning. Scales. Object drawing in 1st and 3rd angle projection. Isometric perspective. Application of projections in engineering drawings using both manual and computational methods.

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Silva, A. Desenho técnico moderno. 4th ed. Rio de Janeiro: LTC, 2006. 475 p. ISBN 978-85-21615-22-4.
Silva, J. C. da. Desenho técnico mecânico. 2nd rev. ed. Florianópolis: Ed. da UFSC, 2009. 116 p. ISBN 978-85-32804-62-4.
Speck, H. J.; Peixoto, V. V. Manual básico de desenho técnico. 6th rev. ed. Florianópolis: Ed. da UFSC, 2010. ISBN 978-85-32805-08-9.

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Manfé, G.; Pozza, R.; Scarato, G. Desenho técnico mecânico. São Paulo: Hemus, 2004. ISBN 978-85-28900-07-1.
Souza, A. F.; Ulbrich, C. B. L. Engenharia integrada por computador e sistemas CAD/CAM/CNC: princípios e aplicações. 2nd ed. São Paulo: Artliber, 2013. ISBN 9788588098909.
Montenegro, G. Desenho de Projetos. São Paulo: Edgard Blucher, 2007. ISBN 978-85-21204-26-8.
Ribeiro, C. P. B. V.; Papazoglou, R. S. Desenho técnico para engenharias. Curitiba: Juruá, 2008. ISBN 9788536216799.
Rodrigues, A. R. Desenho técnico mecânico: projeto e fabricação no desenvolvimento de produtos industriais. Rio de Janeiro: Elsevier, 2015. ISBN 978-85-352-7423-3.

Course: EMB5063 – Science, Technology and Society
Semester: 1
Workload (credits – class hours): 2 credits – 36h
Prerequisite: None
Syllabus
Definitions of science, technology, and technique. Technological and social development. Relations between science, technology, and society. Challenges for the profile of the contemporary engineer. The engineer's role in the technological and social context. Ethics, morals, values, and professional ethics. The Code of Ethics as a tool for strengthening organizational culture. Conscious discipline. Ethnic-racial equality in engineering. Afro-Brazilian and African history and culture. Human rights.

Basic Bibliography

Bazzo, W. A. Ciência, tecnologia e sociedade: e o contexto da educação tecnológica. Florianópolis: Ed. da UFSC, 2010. ISBN 9788532804754.
Bazzo, W. A.; Pereira, L. T. V. Introdução à Engenharia: Conceitos, Ferramentas e Comportamentos. 2nd ed. Florianópolis: Ed. da UFSC, 2008. ISBN 978-85-3280-455-6.
Cherques, H. R. Ética para Executivos. Rio de Janeiro: FGV, 2008. ISBN 978-85-225-0647-7.

Supplementary Bibliography

Bazzo, W. A.; Pereira, L. T. V.; Linsingen, I. von. Educação tecnológica: enfoques para o ensino de engenharia. 2nd ed. Florianópolis: Ed. da UFSC, 2008. ISBN 97885328042204.
Singer, P. Ética prática. 3rd ed. São Paulo: Martins Fontes, 2002. ISBN 9789726627234.
Almeida, P. A. (Coord.). Ética e responsabilidade social nos negócios. São Paulo: Saraiva, 2002.

Araújo, M. P. Construindo o social através da ação e da responsabilidade. Novo Hamburgo: FEEVALE, 2006.
Melo Neto, F. P.; Froes, C. O bem feito: os novos desafios da gestão da responsabilidade socioambiental sustentável corporativa. Rio de Janeiro: Qualitymark, 2011.

Course: EMB5379 – Introduction to Automotive Engineering
Semester: 1
Workload (credits – class hours): 2 credits – 36h
Prerequisite: None
Syllabus
Introduction to academic life (the university, student organizations, support services, physical spaces, and laboratory infrastructure). The Automotive Engineering program: purpose, graduate profile, job market. Introduction to professional life. Responsibilities of the engineer in the technological and social context. Fire and disaster prevention and control in establishments, buildings, and public venues. Introduction to product design concepts: methodologies and tools. Introduction to vehicle systems (suspension, steering, braking, transmission). Introduction to materials and manufacturing processes in automotive construction. Fundamentals of metrology, measurement errors, and appropriate selection of measurement systems. Introduction to internal combustion engines. Fundamentals of embedded systems and electric vehicle design. Ergonomics and vehicle safety aspects.

Basic Bibliography

Bazzo, W. A.; Pereira, L. T. V. Introdução à Engenharia: Conceitos, Ferramentas e Comportamentos. 2nd ed. Florianópolis: Ed. da UFSC, 2008. ISBN 978-85-3280-455-6.
Bazzo, W. A.; Pereira, L. T. V.; von Linsingen, I. Educação Tecnológica: Enfoques para o Ensino de Engenharia. 2nd ed. Florianópolis: Ed. da UFSC, 2008. ISBN 978-85-32804-22-04.
Holtzapple, M.; Reece, W. D. Introdução à Engenharia. 1st ed. São Paulo: LTC, 2006. ISBN 978-85-2161-511-8.

Supplementary Bibliography

Back, N.; Ogliari, A.; Dias, A.; da Silva, J. C. Projeto Integrado de Produtos: Planejamento, Concepção e Modelagem. Barueri: Manole, 2008. ISBN 978-85-2042-208-3.
Brookman, J. B. Introdução à Engenharia: Modelagem e Solução de Problemas. São Paulo: LTC, 2010. ISBN 978-85-2161-726-6.
Filho, E. R.; Ferreira, C. V.; Gouvinhas, R. P.; Naveiro, R. M.; Miguel, P. A. C. Projeto do Produto. Rio de Janeiro: Elsevier, 2010. ISBN 978-85-352-3351-3.
Genta, G.; Morello, L. The Automotive Chassis: System Design. Vol. 2. New York: Springer, 2009. ISBN 978-14-02086-73-1.
Hoag, K. L. Vehicular Engine Design. Warrendale: SAE International/Springer, 2005. ISBN 978-07-68016-61-1.

Course: EMB5036 – Chemistry for Engineering
Semester: 1
Workload (credits – class hours): 4 credits – 72h
Prerequisite: None
Syllabus
International system of units. Atoms and molecules. Chemical bonds and molecular structure. Chemical equations. Stoichiometry. Aqueous solutions. Thermochemistry. Electrochemistry: redox, electrochemical cells, Nernst equation, electrolysis. Metallurgy: pig iron and steel production. Special steels. Polymers: chemical structure, properties, applications. Ceramics: traditional and advanced ceramics, properties, applications. Composites. Metallic corrosion: types and forms, corrosive media, protection mechanisms, monitoring. Fuels and combustion. Environmental chemistry. Laboratory activities.

Basic Bibliography

Brown, L. S.; Holme, T. A. Química Geral Aplicada à Engenharia. São Paulo: Cengage Learning, 2009. ISBN 978-85-22106-88-2.
Gentil, V. Corrosão. 5th ed. Rio de Janeiro: LTC, 2007. ISBN 978-85-21615-56-9.
Canevarolo Jr., S. V. Ciência de Polímeros. 2nd ed. São Paulo: Artliber, 2006. ISBN 978-85-88098-10-7.

Supplementary Bibliography

Brown, T. L.; LeMay Jr., H. E.; Brusten, B. E. Química: a Ciência Central. 9th ed. São Paulo: Pearson Prentice Hall, 2005. ISBN 9788587918420.
Araújo, L. A. Manual de Siderurgia. Vol. 1. São Paulo: Arte & Ciência, 2005. ISBN 978-85-61165-01-7.
Oliveira, A. P. N.; Hotza, D. Tecnologia de fabricação de revestimentos cerâmicos. 2nd ed. Florianópolis: Ed. da UFSC, 2015. ISBN 9788532807106.
Callister Jr., W. D. Ciência e Engenharia dos Materiais: uma introdução. 7th ed. Rio de Janeiro: LTC, 2008. ISBN 978-85-21615-95-8.
Rocha, J. C.; Rosa, A. H.; Cardoso, A. A. Introdução à Química Ambiental. Porto Alegre: Bookman, 2004.

Course: EMB5062 – Communication and Expression

Semester: 2
Workload (credits – class hours): 2 credits – 36h
Prerequisite: None

Syllabus

Reading and interpretation of technical and scientific texts in the field of Engineering. Theoretical and practical study of academic texts such as: notes, summaries, reviews, articles, seminars. ABNT standards relevant to academic writing/production. Technical and scientific language. Current grammatical norms. Exercises in the appropriation of Engineering texts.

Basic Bibliography

Faraco, C. A.; Tezza, C. Prática de texto para estudantes universitários. 21st ed. Petrópolis: Vozes, 2008. ISBN 978-85-326-0842-0.
Fiorin, J. L.; Savioli, F. P. Lições de texto: leitura e redação. 5th ed. São Paulo: Ática, 2006. ISBN 9788508105946.
Lakatos, E. M.; Marconi, M. A. Metodologia do trabalho científico. 7th ed. São Paulo: Atlas, 2011. ISBN 9788522448784.

Supplementary Bibliography

Andrade, M. M. Introdução à metodologia do trabalho científico. 10th ed. São Paulo: Atlas, 2010. ISBN 9788522458561.
Fonseca, M. H. Curso de metodologia na elaboração de trabalhos acadêmicos. Rio de Janeiro: Ciência Moderna, 2009. ISBN 9788573938081.
Marcuschi, L. A. Produção textual, análise de gêneros e compreensão. São Paulo: Parábola, 2008. ISBN 9788588456747.
Martins, D. S.; Zilberknop, L. S. Português instrumental. 29th ed. São Paulo: Atlas, 2010. ISBN 978852457229.
Reiz, P. Redação científica moderna. São Paulo: Hyria, 2013. ISBN 9788566442007.

Course: EMB5007 – Linear Algebra

Semester: 2
Workload (credits – class hours): 4 credits – 72h
Prerequisite: EMB5005 – Analytical Geometry

Syllabus

Vector spaces. Linear transformations. Change of basis. Inner product. Orthogonal transformations. Eigenvalues and eigenvectors. Diagonalization.

Basic Bibliography

Anton, H.; Rorres, C. Álgebra Linear com Aplicações. 8th ed. Porto Alegre: Bookman, 2001. ISBN 978-85-73078-47-3.
Boldrini, J. L. Álgebra Linear. 3rd ed. São Paulo: Harbra, 1986. ISBN 978-85-29402-02-4.
Steinbruch, A.; Winterle, P. Álgebra Linear. 2nd ed. São Paulo: Pearson, 1987. ISBN 978-00-74504-12-3.

Supplementary Bibliography

Callioli, C. A.; Costa, R. C. F.; Domingues, H. H. Álgebra Linear e Aplicações. 6th ed. São Paulo: Atual, 1990. ISBN 978-85-70562-97-5.
Golan, J. S. The Linear Algebra a Beginning Graduate Student Ought to Know. Dordrecht: Springer, 2007. ISBN 978-14-02054-95-2.
Kolman, B.; Hill, D. R. Introdução à Álgebra Linear com Aplicações. 8th ed. Rio de Janeiro: LTC, 2006. ISBN 978-85-21614-78-4.
Lay, D. C. Álgebra Linear e suas Aplicações. 2nd ed. Rio de Janeiro: LTC, 1999. ISBN 978-85-21622-09-3.
Lipschutz, S.; Lipson, M. L. Teoria e Problemas de Álgebra Linear. 3rd ed. Porto Alegre: Bookman, 2004. ISBN 978-85-36303-48-2.

Course: EMB5012 – Drawing and Geometric Modeling

Semester: 2

Workload (credits – class hours): 3 credits – 54h

Prerequisite: EMB5055 – Graphic Representation

Syllabus

CAD systems, methodology for 3D product modeling. Practice with CAD software. Solid modeling techniques. Product modeling, generation of engineering drawings, technical drawing standards, assembly drawings, bills of materials.

Basic Bibliography

Rohleder, E.; Speck, H. J. Tutoriais de Modelagem 3D Utilizando o SolidWorks. 3rd ed. Florianópolis: Visual Books, 2011. ISBN 987-85-75022-37-5.
Silva, J. C. da. Desenho Técnico Mecânico. 2nd ed. Florianópolis: UFSC, 2009. ISBN 978-85-32804-62-4.
Speck, H. J.; Peixoto, V. V. Manual Básico de Desenho Técnico. 6th ed. Florianópolis: UFSC, 2010. ISBN 978-85-32805-08-9.

Supplementary Bibliography

ABNT. Normas Técnicas. Available online: http://www.abnt.org.br
Biblioteca Virtual da USP. Educational materials. http://www.bibvirt.futuro.usp.br
Provenza, F. Desenhista de Máquinas. São Paulo: F. Provenza, 1960. ISBN 978-85-60311-01-9.
Provenza, F. Projetista de Máquinas. 6th ed. São Paulo: Pro-Tec, 1978. ISBN 978-85-60311-00-2.
Silva, A. Desenho Técnico Moderno. 4th ed. Rio de Janeiro: LTC, 2006. ISBN 978-85-21615-22-4.
Souza, A. F.; Ulbrich, C. B. L. Engenharia Integrada por Computador e Sistemas CAD/CAM/CNC. São Paulo: Artliber, 2009. ISBN 978-85-88098-47-3.

Course: EMB5029 – Differential and Integral Calculus II

Semester: 2

Workload (credits – class hours): 4 credits – 72h

Prerequisite: EMB5001 – Calculus I

Syllabus

Integration methods. Applications of the definite integral. Improper integrals. Multivariable functions. Partial derivatives. Applications of partial derivatives. Multiple integration.

Basic Bibliography

Flemming, D. M.; Gonçalves, M. B. Cálculo B. 6th ed. São Paulo: Pearson, 2007. ISBN 978-85-32804-55-6.

Stewart, J. Cálculo. 6th ed. São Paulo: Cengage Learning, 2009. Vol. 1. ISBN 978-85-22106-60-8.
Stewart, J. Cálculo. 6th ed. São Paulo: Cengage Learning, 2009. Vol. 2. ISBN 978-85-22106-61-5.

Supplementary Bibliography

Guidorizzi, H. L. Um Curso de Cálculo. 5th ed. Rio de Janeiro: LTC, 2002. ISBN 978-85-21612-59-9.
Howard, A. Cálculo. 8th ed. Porto Alegre: Artmed, 2007. ISBN 978-85-88639-31-7.
Leithold, L. O Cálculo Com Geometria Analítica. 3rd ed. São Paulo: Harbra, 1985. ISBN 85-294-0206-5.
Simmons, G. F. Cálculo Com Geometria Analítica. São Paulo: Pearson, 2008. ISBN 978-85-34614-68-9.
Thomas, G. B.; et al. Cálculo. 11th ed. São Paulo: Pearson, 2009. ISBN 978-85-88639-36-2.

Course: EMB5648 – Programming I

Semester: 2
Workload (credits – class hours): 4 credits – 72h
Prerequisite: None

Syllabus

Introduction to computer architecture. Programming logic: problem formalization with pseudocode (algorithms) and flowcharts, data types, selection and repetition structures, execution flow, modularization (functions and procedures), homogeneous data structures (arrays and matrices). Introduction to pointers. Files. Practical implementation of algorithms in a high-level language.

Basic Bibliography

Forbellone, A. L. V.; Eberspacher, H. F. Lógica de Programação. 3rd ed. São Paulo: Pearson, 2005. ISBN 8576050242.
Ziviani, N. Projeto de algoritmos. 3rd ed. São Paulo: Cengage Learning, 2011. ISBN 978-85-22110-50-6.
Manzano, J. A. N. G.; Oliveira, J. F. Algoritmos. 29th ed. São Paulo: Érica, 2019. ISBN 978-8536531458.

Supplementary Bibliography

Lopes, A.; Garcia, G. Introdução à Programação: 500 Algoritmos Resolvidos. Rio de Janeiro: Campus, 2002. ISBN 8535210199.
Pinheiro, F. A. C. Elementos de programação em C. Porto Alegre: Bookman, 2012. ISBN 978-85-407-0202-8.
Puga, S.; Rissetti, G. Lógica de Programação e Estruturas de Dados com Aplicações em Java. 2nd ed. São Paulo: Pearson, 2009. ISBN 9788576052074.
Holloway, J. P. Introdução à Programação para Engenharia. São Paulo: LTC, 2006. ISBN 8521614535.
Mizrahi, V. V. Treinamento em linguagem C. 2nd ed. São Paulo: Pearson, 2008. ISBN 975-85-76051-91-6.

Course: EMB5048 – Physics I

Semester: 2
Workload (credits – class hours): 4 credits – 72h
Prerequisite: None

Syllabus

Units of measurement and vectors. Kinematics. Newton’s laws and applications. Work and potential energy. Conservation of energy. Conservation of linear and angular momentum. Rotation of rigid bodies and rolling. Laboratory activities.

Basic Bibliography

Resnick, R.; Halliday, D.; Walker. Fundamentos de Física. 8th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-21616-65-4.
Serway, R. A.; Jewett, J. W. Princípios de Física. São Paulo: Cengage, 2004. ISBN 978-85-22113-82-9.

Tipler, P. A.; Mosca, G. Física para Cientistas e Engenheiros. 6th ed. Rio de Janeiro: LTC, 2012. ISBN 978-85-21617-15-5.

Supplementary Bibliography

Cutnell, J. D.; Johnson, K. W. Física. 6th ed. Rio de Janeiro: LTC, 2012. ISBN 978-85-21614-91-3.
Feynman, R. P.; Leighton, R. B.; Sands, M. The Feynman Lectures on Physics. São Paulo: Perseus, 2011. ISBN 978-04-65024-93-3.
Nussenzveig, M. H. Curso de Física Básica. 4th ed. São Paulo: Edgard Blucher, 2002. ISBN 978-85-21202-98-1.
Sears, F.; Young, H. D.; Freedman, R. A.; Zemansky, M. W. Física. 12th ed. São Paulo: Pearson, 2008. ISBN 978-85-88639-30-0.
Telles, D. D.; Netto, J. M. Física com aplicação tecnológica. São Paulo: Edgard Blucher, 2011. ISBN 978-85-21205-87-6.

Course: EMB5332 – Introduction to Automotive Engineering Design

Semester: 2

Workload (credits – class hours): 2 credits – 36h

Prerequisite: EMB5379 – Introduction to Automotive Engineering

Syllabus

Context and importance of vehicle product design and development. Aspects of vehicle product development: methodologies and tools for vehicle product conception and specification. Production process feasibility. Fundamentals of scientific methods in solving engineering problems. Principles and stages of planning, conducting, and analyzing experiments. Introduction to modeling, analysis, and simulation methods for engineering design. Laboratory practices.

Basic Bibliography

Back, N.; Ogliari, A.; Dias, A.; da Silva, J. C. Projeto Integrado de Produtos. Barueri: Manole, 2008.
Wong, J. Y. Theory of Ground Vehicles. 3rd ed. New York: Wiley, 2001. ISBN 978-0471354611.
Timmis, H. Practical Arduino Engineering. Berkeley: Apress, 2011. ISBN 9781430238867.

Supplementary Bibliography

Genta, G.; Morello, L. The Automotive Chassis: System Design. New York: Springer, 2009. ISBN 978-14-02086-73-1.
Hoag, K. L. Vehicular Engine Design. Warrendale: SAE/Springer, 2005. ISBN 978-07-68016-61-1.
Baxter, M. Projeto do produto: guia prático para o design de novos produtos. São Paulo: Edgard Blücher, 2000.
Brookman, J. B. Introdução à Engenharia: Modelagem e Solução de Problemas. São Paulo: LTC, 2010.
Filho, E. R.; Ferreira, C. V.; Gouvinhas, R. P.; Naveiro, R. M.; Miguel, P. A. C. Projeto do Produto. Rio de Janeiro: Elsevier, 2010.

Course: EMB5011 – Statics

Semester: 3

Workload (credits – class hours): 4 credits – 72h

Prerequisite: EMB5048 – Physics I

Syllabus

Study of equilibrium of particles and rigid bodies in plane and space. Determination of reactions in standard engineering supports. Calculation of centroids of areas and volumes of simple and composite figures. Analysis of distributed loads as concentrated loads. Calculation of surface moment of inertia for simple and composite areas. Calculation of mass moment of inertia for simple and composite solids. Analysis of trusses, frames, and machines. Determination of axial forces, shear forces, and bending moments in structures and beams. Construction of shear force and bending moment diagrams.

Basic Bibliography

Beer, F. P.; Johnston, E. R. Mecânica Vetorial para Engenheiros. 5th ed. São Paulo: Pearson Makron Books, 2005. ISBN 978-85-34602-02-0.
Hibbeler, R. C. Estática: Mecânica para Engenharia. 12th ed. São Paulo: Pearson, 2011. ISBN 978-85-76058-15-1.
Sheppard, S. D. Estática – Análise e Projeto de Sistemas em Equilíbrio. Rio de Janeiro: LTC, 2007. ISBN 978-05-21090-60-5.

Supplementary Bibliography

Beer, F. P. Mecânica Vetorial para Engenheiros. 7th ed. Porto Alegre: McGraw Hill, 2010. ISBN 978-85-86804-45-8.
Hibbeler, R. C. Resistência dos Materiais. 7th ed. São Paulo: Pearson, 2010. ISBN 978-85-76053-73-6.
Nussenzveig, M. H. Curso de Física Básica – Mecânica. 4th ed. São Paulo: Edgard Blucher, 2002. ISBN 978-85-212-0298-1.
Shames, I. H. Estática – Mecânica para Engenharia. 4th ed. São Paulo: Pearson, 2002. ISBN 978-85-87918-13-0.
Tipler, P. A. Física para Cientistas e Engenheiros. 6th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-21617-0-5.

Course: EMB5016 – Numerical Calculus

Semester: 3

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5005 – Analytical Geometry; EMB5001 – Calculus I; EMB5648 – Programming I

Syllabus

Introduction to computational mathematics, errors and floating-point arithmetic. Solution of algebraic and transcendental equations. Solution of linear systems, direct and iterative methods. Solution of nonlinear systems. Interpolation. Curve fitting. Numerical integration.

Basic Bibliography

Burden, R. L.; Faires, J. D. Análise Numérica. 8th ed. São Paulo: Cengage, 2011. ISBN 978-85-22106-01-1.
Chapra, S. C. Métodos Numéricos Aplicados com MATLAB. 3rd ed. Porto Alegre: AMGH, 2013. ISBN 978-85-80551-76-1.
Franco, N. B. Cálculo Numérico. São Paulo: Pearson, 2007. ISBN 978-85-76050-87-2.

Supplementary Bibliography

Barroso, L. C. et al. Cálculo Numérico (com Aplicações). 2nd ed. São Paulo: Harbra, 1987. ISBN 978-85-29400-89-1.
Darezzo, A.; Arenales, S. H. V. C. Cálculo Numérico: Aprendizagem com Apoio de Software. São Paulo: Thomson, 2007. ISBN 978-85-22106-02-8.
Sperandio, D. et al. Cálculo Numérico: Características Matemáticas e Computacionais. São Paulo: Pearson, 2003. ISBN 978-85-87918-74-1.
Chapra, S. C.; Canale, R. P. Métodos Numéricos para Engenharia. 5th ed. São Paulo: McGraw-Hill, 2008. ISBN 978-85-86804-87-8.

Course: EMB5022 – Materials Science

Semester: 3

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5001 – Calculus I; EMB5036 – Chemistry for Engineering

Syllabus

Introduction to Materials Science and Engineering – materials applied in engineering. Types, classification, and applications. Atomic structure and interatomic bonds. Crystalline and non-crystalline materials. Imperfections in solids. Diffusion. Metallographic processes. Equilibrium diagrams. Mechanical and dynamic behavior of materials. Failures: fracture, fatigue, and creep. Structure and properties of metallic, ceramic, and polymeric materials. Introduction to composites.

Basic Bibliography

Askeland, D. R.; Phulé, P. P. Ciência e Engenharia de Materiais. São Paulo: Cengage, 2008. ISBN 978-85-22105-98-4.

Callister Jr., W. D. Ciência e Engenharia dos Materiais: Uma Introdução. 7th ed. Rio de Janeiro: LTC, 2008. ISBN 978-85-21615-95-8.

Van Vlack, L. H. Princípios de Ciência dos Materiais. São Paulo: Edgard Blucher, 1970 (18th reprint, 2011). ISBN 978-85-21201-21-2.

Supplementary Bibliography

Ashby, M. F.; Jones, D. R. H. Engenharia dos Materiais. Rio de Janeiro: Elsevier, 2007. ISBN 978-85-35223-62-0.

Colpaert, H. Metalografia dos Produtos Siderúrgicos Comuns. 4th ed. São Paulo: Edgard Blucher, 2008. ISBN 978-85-21204-49-7.

Padilha, Á. F. Materiais de Engenharia: Microestrutura. 3rd ed. São Paulo: Hemus, 2006. ISBN 978-85-28904-42-0.

Smith, W. F.; Hashemi, J. Fundamentos da Engenharia e Ciência dos Materiais. 5th ed. Porto Alegre: McGraw-Hill, 2012. ISBN 978-85-80551-14-3.

Shackelford, J. F. Ciência dos Materiais. 6th ed. São Paulo: Pearson, 2008. ISBN 978-85-76051-60-2.

Course: EMB5030 – Vector Calculus

Semester: 3

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5029 – Calculus II; EMB5005 – Analytical Geometry

Syllabus

Vector functions. Limits, derivatives, and integrals of vector functions. Parametrization of curves and surfaces. Vector fields. Gradient, divergence, and curl. Line integrals. Surface integrals. Green's theorem. Stokes' theorem. Gauss' theorem.

Basic Bibliography

Kaplan, W. Cálculo Avançado. São Paulo: Edgard Blucher, 1972. ISBN 978-85-21200-47-5.

Kreyszig, E. Matemática Superior para Engenharia. 9th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-21616-44-3.

Stewart, J. Cálculo. 7th ed. São Paulo: Cengage, 2014. ISBN 978-85-22112-59-3.

Supplementary Bibliography

Anton, H.; Bivens, I.; Davis, S. Cálculo. 8th ed. Porto Alegre: Artmed, 2007. ISBN 978-85-60031-80-1.

Guidorizzi, H. L. Um Curso de Cálculo. Rio de Janeiro: LTC, 2002. ISBN 978-85-21612-57.

Simmons, G. F. Cálculo com Geometria Analítica. São Paulo: Pearson, 1996. ISBN 978-85-34614-68-9.

Thomas, G. B.; Weir, M. D.; Hass, J.; Giordano, F. R. Cálculo. 11th ed. São Paulo: Addison Wesley, 2009. ISBN 978-85-88639-36-2.

Zill, D. G.; Cullen, M. R. Matemática Avançada para Engenharia. 3rd ed. Porto Alegre: Bookman, 2009. ISBN 978-85-77804-59-7.

Course: EMB5039 – Physics II

Semester: 3

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5001 – Calculus I; EMB5048 – Physics I

Syllabus

Gravitation. Statics and dynamics of fluids. Oscillations. Mechanical and acoustic waves. Temperature. Heat. Kinetic theory of gases. Laws of thermodynamics. Heat engines. Refrigerators. Entropy.

Basic Bibliography

Halliday, D.; Resnick, R.; Walker, J. Fundamentos da Física – Vol. 2. 8th ed. Rio de Janeiro: LTC, 2012. ISBN 978-85-21616-06-1.
Moyses, N. H. Curso de Física Básica 2 – Fluidos, Oscilações e Ondas, Calor. 4th ed. São Paulo: Edgard Blucher, 2002. ISBN 978-85-21207-47-4.
Tipler, P. A.; Mosca, G. Física para Cientistas e Engenheiros – Vol. 1. 6th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-21617-10-5.

Supplementary Bibliography

Alonso, M.; Finn, E. J. Física: Um Curso Universitário 2 – Campos e Ondas. São Paulo: Edgard Blucher, 1995. ISBN 978-85-21208-33-4.
Chaves, A. Física Básica: Gravitação, Fluidos, Ondas, Termodinâmica. Rio de Janeiro: LTC, 2009. ISBN 978-85-21615-51-4.
Cutnell, J. D.; Johnson, K. W. Física – Vol. 1. 6th ed. Rio de Janeiro: LTC, 2006. ISBN 978-85-21614-91-3.
Knight, R. D. Física: Uma Abordagem Estratégica – Vol. 1. 2nd ed. Porto Alegre: Bookman, 2009. ISBN 978-85-77804-70-2.
Serway, R. A. Física 2. 3rd ed. Rio de Janeiro: LTC, 1996. ISBN 978-85-21610-76-2.

Course: EMB5057 – Statistics I

Semester: 3
Workload (credits – class hours): 4 credits – 72h
Prerequisite: EMB5001 – Calculus I

Syllabus

Descriptive statistics and exploratory data analysis. Probability theory. Discrete and continuous random variables and their main probability distributions. Parameter estimation. Hypothesis testing for parameters: mean, proportion, and variance. Comparison between two treatments.

Basic Bibliography

Barbetta, P. A.; Reis, M. M.; Bornia, A. C. Estatística: para Cursos de Engenharia e Informática. 2nd ed. São Paulo: Atlas, 2008. ISBN 9788522449897.
Montgomery, D. C.; Runger, G. C. Estatística Aplicada e Probabilidade para Engenheiros. 5th ed. Rio de Janeiro: LTC, 2012. ISBN 9788521619024.
Triola, M. F. Introdução à Estatística. 10th ed. Rio de Janeiro: LTC, 2008. ISBN 9788521615866.

Supplementary Bibliography

Devore, J. L. Probabilidade e Estatística para Engenharia e Ciências. São Paulo: Cengage, 2015. ISBN 9788522111831.
Costa Neto, P. L. O. Estatística. 2nd ed. São Paulo: Edgard Blucher, 2002. ISBN 9788521203001.
Meyer, P. L. Probabilidade: Aplicações à Estatística. 2nd ed. Rio de Janeiro: LTC, 1983. ISBN 8521602944.
Ross, S. M. Introduction to Probability and Statistics for Engineers and Scientists. 4th ed. Elsevier, 2009. ISBN 9780123704832.
Spiegel, M. R. Estatística. 3rd ed. São Paulo: Pearson, 2012. ISBN 9788534601207.

Course: EMB5014 – Series and Differential Equations

Semester: 4
Workload (credits – class hours): 4 credits – 72h
Prerequisites: EMB5029 – Calculus II; EMB5007 – Linear Algebra; EMB5016 – Numerical Calculus

Syllabus

Sequences and infinite series. Power series. Taylor series. Fourier series. First-order differential equations. Higher-order linear differential equations. Introduction to Laplace transform. Introduction to partial differential equations. Series solutions for linear differential equations. Numerical methods for solving differential equations.

Basic Bibliography

Boyce, W. E.; DiPrima, R. C.; Iório, V. M. Equações Diferenciais Elementares e Problemas de Valores de Contorno. 9th ed. Rio de Janeiro: LTC, 2002. ISBN 978-85-216-1756-3.
Kreyszig, E. Matemática Superior para Engenharia. Rio de Janeiro: LTC, 2009. ISBN 978-85-216-1644-3.
Thomas, G. B. et al. Cálculo. 11th ed. São Paulo: Pearson, 2009. ISBN 978-85-886-3936-2.

Supplementary Bibliography

Kreyszig, E. Matemática Superior para Engenharia. Rio de Janeiro: LTC, 2009 (Vols. 2 and 3). ISBN 978-85-21616-43-6; 978-85-21616-44-3.
Stewart, J. Cálculo. 7th ed. São Paulo: Cengage, 2014. ISBN 978-85-22112-59-3.
Zill, D. G.; Cullen, M. R. Matemática Avançada para Engenharia. Porto Alegre: Bookman, 2009. ISBN 978-85-77804-00-9; 978-07-63745-91-2.

Course: EMB5021 – Solid Mechanics I

Semester: 4
Workload (credits – class hours): 4 credits – 72h
Prerequisite: EMB5011 – Statics

Syllabus

Stress analysis – concepts and definitions: average normal stress, average shear stress, pure and double shear, allowable stress. Strain analysis – concepts and definitions: normal strain, shear strain. Stress–strain relations – constitutive equations, Hooke's law, Poisson's ratio. Axial loading – thermal deformation, statically indeterminate members, compatibility equations, stress concentration. Torsion – deformation, torsion formula, torsional deflection, stress concentration. Bending – shear force and bending moment diagrams, flexural deformation, simple and oblique bending, asymmetric sections.

Basic Bibliography

Beer, F. P.; Johnston, E. R. Resistência dos Materiais. 3rd ed. São Paulo: Pearson, 1996. ISBN 978-85-34603-44-7.
Hibbeler, R. C. Resistência dos Materiais. 7th ed. Rio de Janeiro: Pearson, 2010. ISBN 978-85-76053-73-6.
Popov, E. Introdução à Mecânica dos Sólidos. Rio de Janeiro: Blucher, 1978. ISBN 978-85-21200-94-9.

Supplementary Bibliography

Beer, F. P.; Johnston, E. R. Mecânica Vetorial para Engenheiros – Estática. 7th ed. Rio de Janeiro: McGraw Hill, 2006. ISBN 978-85-80550-46-7.
Hibbeler, R. C. Estática – Mecânica para Engenharia. 12th ed. São Paulo: Pearson, 2011. ISBN 978-85-76058-15-1.
James, M. G. Mecânica dos Materiais. 7th ed. São Paulo: Cengage, 2010. ISBN 978-85-22107-98-8.
Melconian, S. Mecânica Técnica e Resistência dos Materiais. 18th ed. São Paulo: Érica, 2011. ISBN 978-85-71946-66-8.
Philpot, T. A. Mecânica dos Materiais – Um Sistema Integrado de Ensino. 2nd ed. Rio de Janeiro: LTC, 2013. ISBN 978-85-21621-63-8.

Course: EMB5041 – Dynamics

Semester: 4
Workload (credits – class hours): 3 credits – 54h
Prerequisite: EMB5011 – Statics

Syllabus

Kinematics of rigid bodies. Dynamics of rigid bodies. Work and energy principle. Linear and angular momentum and impulse for rigid bodies.

Basic Bibliography

Beer, F. P.; Johnston, E. R.; Cornwell, P. J. Vector Mechanics for Engineers – Dynamics. 9th ed. São Paulo: McGraw-Hill, 2012. ISBN 978-85-80551-43-3.

Meriam, J. L.; Kraige, L. G. Engineering Mechanics, Vol. II – Dynamics. 6th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-21617-17-4.
Hibbeler, R. C. Dynamics – Engineering Mechanics. 10th ed. São Paulo: Pearson Prentice Hall, 2005. ISBN 978-85-87918-96-3.

Supplementary Bibliography

Nussenzveig, M. H. Curso de Física Básica. 4th ed. São Paulo: Edgard Blucher, 2002. ISBN 978-85-21202-98-1.
Resnick, R.; Halliday, D.; Walker, J. Fundamentals of Physics, Vol. 1 – Mechanics. 8th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-21616-05-4.
Serway, R. A.; Jewett, J. W. Principles of Physics – Classical Mechanics, Vol. 1. São Paulo: Cengage, 2009. ISBN 978-85-22103-82-9.
Thornton, S. T.; Marion, J. B. Classical Dynamics of Particles and Systems. 5th ed. São Paulo: Cengage, 2012. ISBN 978-85-22109-06-7.
Tongue, B. H.; Sheppard, S. D. Dynamics: Analysis and Design of Systems in Motion. São Paulo: LTC, 2007. ISBN 978-85-21615-42-2.

Course: EMB5043 – Physics III

Semester: 4

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5030 – Vector Calculus; EMB5039 – Physics II

Syllabus

Coulomb's Law. Electric field and electrostatic potential. Capacitance and capacitors. Electric current. Magnetic field. Ampere's Law. Law of induction. Circuits. Maxwell's equations. Laboratory activities.

Basic Bibliography

Nussenzveig, H. M. Curso de Física Básica 3: Electromagnetism. São Paulo: Edgard Blucher, 1997. ISBN 978-85-21201-34-2.
Tipler, P. A.; Mosca, G. Physics for Scientists and Engineers, Vol. 2. 6th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-21617-11-2.
Young, H. D.; Freedman, R. A. Physics III – Electromagnetism. 12th ed. São Paulo: Addison Wesley, 2008. ISBN 978-85-88639-34-8.

Supplementary Bibliography

Bastos, J. P. de A. Electromagnetism for Engineering: Static and Quasi-static. Florianópolis: UFSC Press, 2004. ISBN 978-85-32803-06-7.
Purcell, E. M. Electricity and Magnetism. São Paulo: Edgard Blucher, 1973. (Berkeley Physics Course, Vol. 2).
Halliday, D.; Resnick, R.; Walker, J. Fundamentals of Physics, Vol. 3 – Electromagnetism. 9th ed. Rio de Janeiro: LTC, 2011. ISBN 978-85-21619-05-5.
Notaros, B. M. Electromagnetics. São Paulo: Pearson, 2011. ISBN 978-85-64574-26-7.
Serway, R. A.; Jewett, J. W. Principles of Physics – Vol. III. São Paulo: Cengage, 2005. ISBN 978-85-22104-14-7.

Course: EMB5009 – Thermodynamics

Semester: 4

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5029 – Calculus II; EMB5039 – Physics II

Syllabus

Introduction and basic concepts. Work and heat. Properties of pure substances. First law of thermodynamics. First law applied to control volumes. Second law of thermodynamics. Entropy and the second law.

Basic Bibliography

Çengel, Y. A.; Boles, M. A. Thermodynamics. 7th ed. São Paulo: McGraw-Hill, 2013. ISBN 978-85-80552-00-3.
Sonntag, R. E.; Borgnakke, C. Fundamentals of Thermodynamics. 7th ed. São Paulo: Edgard Blucher, 2009. ISBN 978-85-212-0490-9.
Moran, M. J.; Shapiro, H. N. Fundamentals of Engineering Thermodynamics. 6th ed. Rio de Janeiro: LTC, 2009. ISBN 978-85-216-1689-4.

Supplementary Bibliography

Pauken, M. Thermodynamics For Dummies. Wiley, 2011. ISBN 978-1-118-12098-9.
Nussenzveig, H. M. Curso de Física Básica 2: Fluids, Oscillations, and Heat. 5th ed. São Paulo: Edgard Blucher, 2014. ISBN 978-85-21207-47-4.
Kondepudi, D. K.; Prigogine, I. Modern Thermodynamics: From Heat Engines to Dissipative Structures. Wiley, 1998. ISBN 978-04-71973-94-2.
Tester, J. W.; Modell, M. Thermodynamics and Its Applications. 3rd ed. Prentice Hall, 1996. ISBN 978-01-39153-56-3.

Course: EMB5059 – Project Methodology

Semester: 4
Workload (credits – class hours): 4 credits – 72h
Prerequisite: 800h completed in the program

Syllabus

Introduction: context and importance of product design. Models of the process and planning of product/service design. Methods and tools for problem specification and product/service conceptual design. Preliminary design: modeling, analysis, and simulation of design solutions. Detailed design. Prototyping techniques. Community-based design projects. Techniques and concepts of Universal Design in engineering projects.

Basic Bibliography

Ahrens, C. H. et al. Rapid Prototyping: Technologies and Applications. São Paulo: Edgard Blucher, 2007. ISBN 8521203888.
Back, N.; Ogliari, A.; Silva, J. C.; Dias, A. Integrated Product Design: Planning, Conception, and Modeling. São Paulo: Manole, 2008. ISBN 978-85-20422-08-3.
Cambiaghi, S. Universal Design. São Paulo: Senac, 2017. ISBN 85-39-61304-2.

Supplementary Bibliography

Romeiro Filho, E.; Ferreira, C. V.; Miguel, P. A. C.; Gouvinhas, R. P.; Naveiro, R. M. Product Design. Rio de Janeiro: Elsevier, 2010. ISBN 85-35233-51-2.
Rozenfeld, H.; Forcellini, F. A.; Amaral, D. C.; Toledo, J. C.; Silva, S. L.; Alliprandini, D. H.; Scalice, R. K. Product Development Management: A Reference for Process Improvement. São Paulo: Saraiva, 2006. ISBN 85-02054-46-5.
ABNT. NBR 9050:2020 – Accessibility in Buildings, Furniture, Spaces, and Urban Equipment. Rio de Janeiro, 2021.
Gomes, M.; Quaresma, M. Introduction to Inclusive Design. Curitiba: Appris, 2018. ISBN 978-8547310332.
Leite, H. A. R. et al. Product Project Management: The Excellence of the Automotive Industry. São Paulo: Atlas, 2007. ISBN 978-85-2244-886-9.
Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, K.-F. Engineering Design: Fundamentals of Effective Product Development, Methods and Applications. São Paulo: Edgard Blucher, 2005. ISBN 978-85-21203-63-6.
Paubel, E. F. C. Propulsion and Control of Aerospace Vehicles: An Introduction. Florianópolis: UFSC Press, 2002. ISBN 978-85-32802-59-0.
A Guide to the Project Management Body of Knowledge (PMBOK Guide). 4th ed. Project Management Institute, 2009. ISBN 978-19-33890-70-8.

Course: EMB5061 – Metrology

Semester: 5
Workload (credits – class hours): 3 credits – 54h
Prerequisite: EMB5057 – Statistics I

Syllabus

Fundamental concepts of scientific and industrial metrology. International System of Units (SI). Direct and indirect measurements. Measurement errors. Characteristics of measurement systems. Calibration and metrological traceability. Estimation of measurement uncertainty. Metrological confirmation. Laboratory practices (mechanical and electrical quantities).

Basic Bibliography

Gonçalves Jr., A. A.; Sousa, A. R. Fundamentals of Scientific and Industrial Metrology. Barueri: Manole, 2008. ISBN 9788520421161.

Lira, F. A. de. Metrology in Industry. 7th ed. São Paulo: Érica, 2010. ISBN 9788571947832.

Inmetro. International Vocabulary of Metrology (VIM 2012). Duque de Caxias: INMETRO, 2012. ISBN 9788586920097. Available at: INMETRO VIM 2012.

Supplementary Bibliography

Inmetro. Evaluation of Measurement Data: Guide to the Expression of Uncertainty in Measurement (GUM 2008). Duque de Caxias: INMETRO/CICMA/SEPIN, 2012. ISBN 9788586920134. Available at: INMETRO GUM 2008.

EA. Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M). European Accreditation, 2013. Available at: EA-4/02 M.

Rabinovich, S. G. Evaluating Measurement Accuracy: A Practical Approach. Springer, 2010. ISBN 9781441914569. Available at: https://doi.org/10.1007/978-1-4419-1456-9

Hebra, A. The Physics of Metrology: All about Instruments: From Trundle Wheels to Atomic Clocks. Vienna: Springer, 2010. ISBN 9783211783818. Available at: https://doi.org/10.1007/978-3-211-78381-8

Silva Neto, J. C. Metrology and Dimensional Control. Rio de Janeiro: Elsevier, 2012. ISBN 9788535255799.

Course: EMB5102 – Manufacturing Processes

Semester: 5
Workload (credits – class hours): 4 credits – 72h
Prerequisite: EMB5022 – Materials Science

Syllabus

Classification and summary description of manufacturing processes. Fundamentals of continuous and mold casting: main parameters, tools, machines, equipment, and applications. Fundamentals of metal forming processes (rolling, forging, drawing, extrusion, and stamping): parameters, tools, machines, equipment, and applications. Fundamentals of powder metallurgy: sintering. Fundamentals of machining processes: turning, drilling, milling, grinding, electrical discharge machining. Main machining parameters. Cutting tools: materials, coatings, geometry, and wear. Surface quality after specific processes, dimensional errors. Machines and equipment. Introduction to Computer Numerical Control (CNC). Basics of CNC programming and simulation, and integration of CAD/CAM/CNC systems.

Basic Bibliography

Diniz, A. E.; Marcondes, F. C.; Coppini, N. L. Technology of Material Machining. 6th ed. São Paulo: Artliber, 2008. ISBN 8587296019.

Ferraresi, D. Machining of Metals. São Paulo: Blucher, 1970. ISBN 9788521208594.

Helman, H.; Cetlin, P. R. Fundamentals of Metal Forming. 2nd ed. São Paulo: Artliber, 2010. ISBN 9788588098282.

Supplementary Bibliography

Araújo, L. A. Manual of Steelmaking. 2nd ed. São Paulo: Arte & Ciência, 2005. ISBN 9788561165017.

Schaeffer, L. Metal Forming: Applied Calculations in Manufacturing Processes. Porto Alegre: Imprensa Livre, 2007. ISBN 9788576970736.
Silva, A. L. V. C.; Mei, P. R. Special Steels and Alloys. 3rd ed. São Paulo: Blucher, 2010. ISBN 9788521205180.
Souza, A. F.; Ulbrich, C. B. L. Computer Integrated Engineering and CAD/CAM/CNC Systems: Principles and Applications. São Paulo: Artliber, 2009. ISBN 9788588098473.
Rodrigues, A. R.; Souza, A. F.; Brandão, L. C.; Silveira, Z. C. Mechanical Technical Drawing: From Product Planning to Quality Control. Elsevier, 2015. ISBN 978-85-352-7423-3.

Course: EMB5104 – Strength of Materials II
Semester: 5
Workload (credits – class hours): 4 credits – 72h
Prerequisite: EMB5021 – Strength of Materials I
Syllabus
Shear in long beams – shear stresses in beams; shear in composite structures. Combined loading – stress fields in thin cylindrical and spherical shells. Pressure vessels. Stress transformation – Plane stress state, principal stresses, Mohr's circle. Beam deflection – elastic curve, equilibrium equations, statically indeterminate beams. Column buckling – critical load; elastic and inelastic buckling of beams. Static failure criteria for ductile materials – Maximum Shear Stress Theory; Distortion Energy Theory, von Mises equivalent stress, safety factor. Static failure criterion for brittle materials – Maximum Normal Stress Theory. Energy methods.

Basic Bibliography
Hibbeler, R. C. Mechanics of Materials. 7th ed. Rio de Janeiro: Pearson, 2010. ISBN 978-85-76053-73-6.
Popov, E. Introduction to Mechanics of Solids. Rio de Janeiro: Blucher, 1978. ISBN 978-85-21200-94-9.
Philpot, T. A. Mechanics of Materials: An Integrated Learning System. 2nd ed. Rio de Janeiro: LTC, 2013. ISBN 978-85-21621-63-8.
Supplementary Bibliography
Beer, F. P.; Johnston, E. R. Mechanics of Materials. 3rd ed. São Paulo: Pearson, 1996. ISBN 978-85-34603-44-7.
Gere, J. M. Mechanics of Materials. São Paulo: Pioneira, 2010. ISBN 9788522107988.
Riley, W. F.; Sturges, L. D.; Morris, D. H. Mechanics of Materials. 5th ed. Rio de Janeiro: LTC, 2003. ISBN 8521613628.
Kim, N. H.; Sankar, B. Introduction to Finite Element Analysis and Design. Rio de Janeiro: LTC, 2011. ISBN 978-85-21617-88-4.
Ugural, A. C. Mechanics of Materials. Rio de Janeiro: LTC, 2009. ISBN 9788521616870.

Course: EMB5101 – Mechanisms
Semester: 5
Workload (credits – class hours): 2 credits – 36h
Prerequisite: EMB5041 – Dynamics
Syllabus
Concepts and notations applied to mechanisms. Fundamentals of kinematics of mechanisms. Elementary concepts and dimensional synthesis of articulated mechanisms. Cam design. Kinematic analysis of spur gears. Compound gear trains.

Basic Bibliography
Norton, R. L. Kinematics and Dynamics of Machinery. 8th ed. Porto Alegre: McGraw-Hill/AMGH, 2010. ISBN 978-85-63308-19-1.
Norton, R. L. Machine Design: An Integrated Approach. 2nd ed. Porto Alegre: Bookman, 2004. ISBN 978-85-36302-73-7.

Budynas, R. G.; Nisbett, J. K. Shigley's Mechanical Engineering Design. 8th ed. Porto Alegre: AMGH, 2011. ISBN 978-85-63308-20-7.

Supplementary Bibliography

Mabie, H. H.; Ocvirk, F. W. Mechanisms. 2nd ed. Rio de Janeiro: LTC, 1980. ISBN 978-85-216021-3.
Erdman, A. G.; Sandor, G. N.; Kota, S. Mechanism Design: Analysis and Synthesis. 4th ed. New York: Prentice Hall, 2001. ISBN 978-01-30408-72-3.
Mallik, A. K.; Ghosh, A.; Dittrich, G. Kinematic Analysis and Synthesis of Mechanisms. Boca Raton: CRC Press, 1994. ISBN 978-08-49391-21-7.
Provenza, F. Machine Drafting. São Paulo: F. Provenza, 1960. ISBN 978-85-60311-01-9.
Provenza, F. Machine Design. 6th ed. São Paulo: Pro-Tec, 1978. ISBN 978-85-60311-00-2.

Course: EMB5017 – Fluid Mechanics

Semester: 5

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5009 – Thermodynamics; EMB5030 – Vector Calculus

Syllabus

Fundamental concepts. Fluid statics. Integral and differential formulation of conservation laws. Incompressible inviscid flow. Dimensional analysis and similarity. Incompressible viscous internal flow: fully developed laminar flow and flow in pipes and ducts. Incompressible viscous external flow: boundary layer theory, drag, and lift forces on immersed bodies.

Basic Bibliography

Çengel, Y. A.; Cimbala, J. M. Fluid Mechanics: Fundamentals and Applications. São Paulo: McGraw-Hill, 2008. ISBN 978-85-86804-58-8.
Fox, R. W.; McDonald, A. T.; Pritchard, P. J. Introduction to Fluid Mechanics. 7th ed. Rio de Janeiro: LTC, 2010. ISBN 978-85-21617-57-0.
Munson, B. R.; Young, D. F.; Okiishi, T. H. Fundamentals of Fluid Mechanics. São Paulo: Blucher, 2004. ISBN 978-85-21203-43-8.

Supplementary Bibliography

Batchelor, G. K. An Introduction to Fluid Dynamics. Cambridge: Cambridge University Press, 2000. ISBN 978-05-21663-96-0.
Kundu, P. K.; Cohen, I. M.; Dowling, D. R. Fluid Mechanics. 5th ed. Academic Press, 2011. ISBN 978-01-23821-00-3.
Street, R. L.; Watters, G. Z.; Vennard, J. K. Elementary Fluid Mechanics. Wiley, 1995. ISBN 978-04-71013-10-5.
White, F. M. Fluid Mechanics. 7th ed. McGraw-Hill, 2010. ISBN 978-00-77422-41-7.
White, F. M. Viscous Fluid Flow. 3rd ed. McGraw-Hill, 2005. ISBN 978-00-72402-31-5.

Course: EMB5120 – Management and Organization

Semester: 5

Workload (credits – class hours): 4 credits – 72h

Prerequisite: 1400h/a

Syllabus

History of general management theory. Basic approaches and evolution of administrative thought. Concept of administration and management functions. Production and operations management. Production and operations strategy. Planning and production control. Just-in-Time and Lean Operations. Quality management. Human resources management. Basics of entrepreneurship.

Basic Bibliography

Slack, N.; Stuart, C.; Johnson, R. Operations Management. 3rd ed. São Paulo: Atlas, 2009. ISBN 9788522453535.
Chiavenato, I. Introduction to General Management Theory. 8th ed. Rio de Janeiro: Elsevier, 2011. ISBN 9788535246711.

Krajewski, L. J.; Ritzman, L. P.; Malhotra, M. K. Production and Operations Management. São Paulo: Pearson Prentice Hall, 2009. ISBN 9788587918383.

Supplementary Bibliography

Davis, M. M.; Aquilano, N. J.; Chase, R. B. Fundamentals of Operations Management. 7th ed. Bookman, 2001. ISBN 9788573075243.
Corrêa, H. L.; Gianesi, I. G. N.; Caon, M. Production Planning and Control: MRP II/ERP. 5th ed. São Paulo: Atlas, 2007. ISBN 9788522448531.
Sobral, F.; Peci, A. Management: Theory and Practice in the Brazilian Context. 2nd ed. São Paulo: Pearson, 2013. ISBN 9788581430850.
Tubino, D. F. Production Planning and Control: Theory and Practice. 2nd ed. São Paulo: Atlas, 2009. ISBN 9788522456949.
Dornelas, J. C. A. Entrepreneurship: Turning Ideas into Business. 3rd ed. Rio de Janeiro: Campus, 2008. ISBN 9788535232707.

Course: EMB5108 – Electric Circuits

Semester: 5

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5005 – Analytic Geometry; EMB5029 – Calculus II

Syllabus

Basic concepts and fundamental laws. Direct current (DC) circuits. Alternating current (AC) circuits. Power analysis in AC circuits. Three-phase circuits.

Basic Bibliography

Nilsson, J. W.; Riedel, S. A. Electric Circuits. 8th ed. São Paulo: Pearson Prentice Hall, 2009. ISBN 9788576051596.
Sadiku, M. N. O.; Alexander, C. K. Fundamentals of Electric Circuits. 3rd ed. São Paulo: McGraw Hill, 2008. ISBN 9788586804977.
Boylestad, R. L. Introductory Circuit Analysis. 10th ed. São Paulo: Pearson, 2004. ISBN 8587918184.

Supplementary Bibliography

Irwin, J. D. Engineering Circuit Analysis. 4th ed. São Paulo: Pearson, 2010. ISBN 9788534606936.
Markus, O. Electric Circuits: DC and AC. São Paulo: Érica, 2007. ISBN 8571947686.
Dorf, R. C.; Svoboda, J. A. Introduction to Electric Circuits. 8th ed. Rio de Janeiro: LTC, 2012. ISBN 9788521621164.
Capuano, F. G.; Marino, M. A. M. Electricity and Electronics Laboratory. 24th ed. São Paulo: Érica, 2007. ISBN 9788571940161.
Ferreira, B.; van der Merwe, W. The Principles of Electronic and Electromechanic Power Conversion: A Systems Approach. Wiley-IEEE Press, 2014. ISBN 1118656091.

Course: EMB5316 – Vehicle Dynamics

Semester: 6

Workload (credits – class hours): 4 credits – 72h

Prerequisite: EMB5041 – Dynamics

Syllabus

Introduction to vehicle dynamics. Mechanical characteristics of tires. Longitudinal dynamics. Vertical dynamics. Lateral dynamics. Rollover. Case studies. Automotive kinematics.

Basic Bibliography

Nicolazzi, L. C.; Rosa, E.; Leal, L. C. M. Motor Vehicles: An Engineering Vision. Orsa Maggiore, 2023. ISBN 978-65-993681-6-5.
Gillespie, T. D. Fundamentals of Vehicle Dynamics. SAE International, 1992. ISBN 978-15-60911-99-9.
Puhn, F. How to Make Your Car Handle. HP Books, 1987. ISBN 978-09-12656-46-5.

Supplementary Bibliography

Bastow, D.; Howard, G. P. Car Suspension and Handling. SAE International, 1997. ISBN 978-07-68008-72-2.
Jazar, R. N. Vehicle Dynamics: Theory and Application. Springer, 2009. ISBN 978-0387742434.
Bosch, R. Automotive Handbook. São Paulo: Blucher, 2005. ISBN 978-85-2120378-0.
Pacejka, H. Tire and Vehicle Dynamics. 3rd ed. Butterworth-Heinemann, 2012. ISBN 978-0080970165.
Guiggiani, M. The Science of Vehicle Dynamics: Handling, Braking, and Ride of Road and Race Cars. Springer, 2014. ISBN 978-94-01785327.

Course: EMB5032 – Environmental Impact Assessment
Semester: 6
Workload (credits – class hours): 2 credits – 36h
Prerequisites: None
Syllabus
Environmental pollution. Pollution control of soil, water, and air. Environmental impacts. Environmental management. Cleaner production. Technological risks and impacts.

Basic Bibliography
Cunha, S. B.; Guerra, A. J. T. Environmental Assessment and Expertise. 6th ed. Rio de Janeiro: Bertrand Brasil, 2005. ISBN 978-85-2860-69-8.
Frangetto, F. W. Environmental Arbitration: Conflict Resolution in National and International Contexts. Millennium, 2006. ISBN 978-85-60755-32-5.
Guerra, A. J. T.; Cunha, S. B. Urban Environmental Impacts in Brazil. 2nd ed. Rio de Janeiro: Bertrand Brasil, 2001. ISBN 978-85-28608-02-1.

Supplementary Bibliography
Romeiro, A. R. Evaluation and Accounting of Environmental Impacts. UNICAMP, 2004. ISBN 978-85-70602-94-7.
Sánches, L. H. Environmental Impact Assessment: Concepts and Methods. 2nd ed. Oficina de Textos, 2013. ISBN 978-85-79750-90-8.
Santos, R. F. Environmental Planning: Theory and Practice. Oficina de Textos, 2004. ISBN 978-85-86238-62-8.
Saroldi, M. J. L. de A. Environmental Expertise and Its Areas of Practice. Lumen Juris, 2009. ISBN 978-85-37505-35-9.
Trennepohl, C.; Trennepohl, T. D. Environmental Licensing. 4th ed. Impetus, 2011. ISBN 978-85-76265-24-5.

Course: EMB5115 – Vibrations
Semester: 6
Workload (credits – class hours): 4 credits – 72h
Prerequisites: EMB5014 – Differential Equations; EMB5041 – Dynamics
Syllabus
Introduction to vibration problems in engineering. Terminology. Basic principles. Single-degree-of-freedom systems: free vibration, energy methods, damping, and forced vibration. Two-degree-of-freedom systems: free and forced vibration. Multi-degree-of-freedom systems. Introduction to continuous systems. Introduction to vibration measurement systems.

Basic Bibliography
Rao, S. S. Mechanical Vibrations. 4th ed. São Paulo: Prentice Hall, 2008. ISBN 978-85-76052-00-5.
Inman, D. J. Engineering Vibration. 3rd ed. Upper Saddle River: Pearson Prentice Hall, 2001. ISBN 0132281732.
Balachandran, B.; Magrab, E. B. Mechanical Vibrations. 2nd ed. São Paulo: Cengage, 2011. ISBN 978-85-22109-05-0.

Supplementary Bibliography

Sotelo Jr., J.; França, L. N. F. Introduction to Mechanical Vibrations. Edgard Blucher, 2006. ISBN 978-85-21203-38-4.
Meirovitch, L. Fundamentals of Vibrations. Waveland Press, 2010. ISBN 9781577666912.
Bishop, R. E. D.; Johnson, D. C. The Mechanics of Vibration. Cambridge University Press, 2011. ISBN 9781107402454.
Ardema, M. D. Analytical Dynamics: Theory and Applications. Kluwer Academic, 2004. ISBN 9780306486814.
Inman, D. J. Vibration with Control. John Wiley & Sons, 2006. ISBN 0470010517.

Course: EMB5352 – Fracture Mechanics
Semester: 6
Workload (credits – class hours): 2 credits – 36h
Prerequisite: EMB5104 – Mechanics of Solids II
Syllabus
Design for failure: types of mechanical failures and fracture types. Failure criteria for brittle materials. Linear Elastic Fracture Mechanics (LEFM): stress intensity factor, fracture toughness. Elastic-Plastic Fracture Mechanics: plastic zone, fracture toughness determination. Fatigue failure: cyclic loading types, finite life design, infinite life design, fatigue crack growth, damage-tolerant design.

Basic Bibliography
Broek, D. The Practical Use of Fracture Mechanics. Springer, 2012.
Shigley, J. E.; Mischke, C. R.; Budynas, R. G. Mechanical Engineering Design. 7th ed. Porto Alegre: Bookman, 2005.
Norton, R. L. Machine Design: An Integrated Approach. 5th ed. Porto Alegre: Bookman, 2013. ISBN 978-85-82600-22-1.

Supplementary Bibliography
Broek, D. Elementary Engineering Fracture Mechanics. 4th ed. Dordrecht: Kluwer, 1982. ISBN 978-90-24726-56-1.
Rosa, E. Mechanical Strength Analysis. UFSC, available online.
Hertzberg, R. W. Deformation and Fracture Mechanics of Engineering Materials. 4th ed. Wiley, 1996.
Developments in Fracture Mechanics: The Mechanics and Mechanisms of Fracture in Metals. Applied Science Publishers, 1981.
Suresh, S. Fatigue of Materials. 2nd ed. Cambridge University Press, 1998. ISBN 0521578477.

Course: EMB5353 – Computer-Aided Manufacturing (CAM)
Semester: 6
Workload (credits – class hours): 2 credits – 36h
Prerequisite: EMB5102 – Manufacturing Processes
Syllabus
Computer Integrated Manufacturing (CIM). Application of CAD/CAM systems for CNC programming and machining process simulation. Machining operations and cutting strategies. Tool path calculation methods in CAM systems. CNC program post-processing. Machining of complex geometries in automotive industries. CNC program transfer and execution. Use of CNC machines and CNC program generation manually and via CAD/CAM systems. Geometric deviations and machined surface quality in CNC machining.

Basic Bibliography
De Souza, A. F.; Ulbrich, C. B. L. Computer-Integrated Engineering and CAD/CAM/CNC Systems: Principles and Applications. São Paulo: Artliber, 2013. ISBN 978-85-88098-90-9.
Diniz, A. E.; Marcondes, F. C.; Coppini, N. L. Machining Technology of Materials. 6th ed. São Paulo: Artliber, 2008.

Souza, A. F.; Rodrigues, A. R.; Brandão, L. C.; Silveira, Z. C. Mechanical Technical Drawing: From Product Planning to Quality Control. Elsevier, 2015. ISBN 9788535274240.

Supplementary Bibliography

Souza, A. F.; Coelho, R. T.; Rodrigues, A. R. Manufacturing Complex Geometries Using High Speed Cutting Technology. Saarbrücken: DM Verlag Dr. Müller, 2011. ISBN 978-36-39262-27-8.
Bowman, A.; Bowman, D. J. Understanding CAD/CAM. Howard W. Sams, 1987.
Chang, T. C.; Wysk, R. A.; Wang, H. P. Computer-Aided Manufacturing. 2nd ed. Pearson, 2005.
McMahon, C.; Browne, J. CAD/CAM: Principles, Practice, and Manufacturing Management. 2nd ed. Pearson, 1998.
Lee, K. Principles of CAD/CAM/CAE Systems. Addison-Wesley, 1999.
Rehg, J. A.; Kraebber, H. W. Computer-Integrated Manufacturing. 3rd ed. Pearson Prentice Hall, 2005.
Leondes, C. T. Computer Aided and Integrated Manufacturing Systems. World Scientific, 2003.

Course: EMB5431 – Fundamentals of Combustion

Semester: 6

Workload (credits – class hours): 3 credits – 54h

Prerequisites: EMB5014 – Differential Equations; EMB5017 – Fluid Mechanics

Syllabus

Introduction and fundamental definitions. Thermochemistry. Chemical kinetics. Thermochemical coupling in reactive systems. Premixed laminar flames. Diffusion laminar flames. Liquid combustion. Introduction to turbulent combustion.

Basic Bibliography

Turns, S. R. Introduction to Combustion: Concepts and Applications. 3rd ed. São Paulo: McGraw-Hill, 2013. ISBN 978-85-80552-74-4.
Coelho, P.; Costa, M. Combustion. 2nd ed. Amadora: Orion, 2012. ISBN 978-97-28620-10-3.
Kuo, K. K. Fundamentals of Turbulent and Multi-Phase Combustion. Wiley, 2012. ISBN 978-04-70226-22-3.

Supplementary Bibliography

Glassman, I.; Yetter, R. Combustion. 4th ed. Academic Press, 2008. ISBN 978-01-20885-73-2.
Turns, S. R. An Introduction to Combustion. 3rd ed. McGraw-Hill, 2011. ISBN 978-00-73380-19-3.
Kuo, K. K. Applications of Turbulent and Multi-Phase Combustion. Wiley, 2012. ISBN 978-11-18127-56-8.
Williams, F. A. Combustion Theory. 2nd ed. Westview Press, 1994. ISBN 978-02-01407-77-8.
Dibble, R. W.; Warnatz, J.; Maas, U. Combustion: Physical and Chemical Fundamentals, Modelling and Simulations, Experiments, Pollutant Formation. 4th ed. Springer, 2006. ISBN 978-35-40259-92-3.

Course: EMB5103 – Heat Transfer I

Semester: 6

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5014 – Differential Equations; EMB5017 – Fluid Mechanics

Syllabus

Basic heat transfer mechanisms. Fundamentals of heat conduction. One-dimensional steady-state conduction. Two-dimensional steady-state conduction. Transient conduction. Applied numerical methods. Fundamentals of thermal radiation. Radiation between surfaces. Introduction to convection.

Basic Bibliography

Incropera, F. P.; DeWitt, D. P.; Bergman, T. L.; Lavine, A. S. Fundamentals of Heat and Mass Transfer. 6th ed. Rio de Janeiro: LTC, 2008. ISBN 978-85-21615-84-2.
Çengel, Y. A. Heat and Mass Transfer: A Practical Approach. 3rd ed. São Paulo: McGraw-Hill, 2009. ISBN 978-85-77260-75-1.

Kreith, F.; Bohn, M. S. Principles of Heat Transfer. São Paulo: Cengage, 2003. ISBN 978-85-22102-84-6.

Supplementary Bibliography

Kaviany, M. Principles of Heat Transfer. Wiley-Interscience, 2001. ISBN 978-04-71434-63-4.
Maliska, C. R. Computational Heat Transfer and Fluid Mechanics. 2nd ed. Rio de Janeiro: LTC, 2004. ISBN 978-85-21613-96-1.
Patankar, S. Numerical Heat Transfer and Fluid Flow. CRC Press, 1980. ISBN 978-08-91165-22-4.
Lienhard IV, J. H.; Lienhard V, J. H. A Heat Transfer Textbook. 4th ed. Dover Publications, 2011. ISBN 978-04-86479-31-6.
Kaviany, M. Heat Transfer Physics. Cambridge University Press, 2008. ISBN 978-05-21898-97-3.

Course: EMB5961 – Engineering Economics

Semester: 6

Workload (credits – class hours): 3 credits – 54h

Prerequisites: EMB5057 – Statistics I; 1400 class hours

Syllabus

Fundamentals of economics. Basic principles of Engineering Economics. Financial mathematics. Investment and financing modalities. Bases for comparison of investment alternatives. Taxes and depreciation. Cost-volume-profit (CVP) analysis. Sensitivity analysis. Equipment replacement analysis. Evaluation of alternatives under risk and uncertainty. Topics on finance and investment. Use of simulation in Engineering Economics through case studies.

Basic Bibliography

Casarotto Filho, N.; Kopittke, B. H. Investment Analysis: Financial Mathematics, Engineering Economics, Decision-Making, Business Strategy. 11th ed. São Paulo: Atlas, 2010. ISBN 978-8522457-89-2.
Hirschfeld, H. Engineering Economics and Cost Analysis: Practical Applications for Engineers, Investment Analysts, and Managers. 7th ed. São Paulo: Atlas, 2009. ISBN 978-85-22426-62-1.
Assaf Neto, A. Financial Mathematics and Its Applications. 10th ed. São Paulo: Atlas, 2008. ISBN 978-85-22448-89-0.

Supplementary Bibliography

Gitman, L. J. Principles of Managerial Finance. 10th ed. São Paulo: Pearson, 2010. ISBN 978-85-88639-12-6.
Motta, R. R.; Costa, R. P.; Neves, C.; Calôba, G.; Gonçalves, A.; Nakagawa, M. Engineering Economics and Finance. Rio de Janeiro: Elsevier, 2008. ISBN 978-85-35232-10-3.
Souza, A.; Clemente, A. Financial Decisions and Investment Analysis: Fundamentals, Techniques and Applications. 6th ed. São Paulo: Atlas, 2008. ISBN 978-85-22450-37-4.
Gonçalves, A. Engineering Economics and Finance. Rio de Janeiro: Elsevier, 2009. ISBN 9788535232103.
Montoro Filho, A. F. et al. Economics Manual. 6th ed. São Paulo: Saraiva, 2013. ISBN 978-85-02135-05-5.

Course: EMB5119 – Machine Elements

Semester: 7

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5104 – Mechanics of Solids II; EMB5101 – Mechanisms

Syllabus

Study of bolted joints. Helical springs. Shafts. Hub-shaft connections. Rolling and sliding bearings. Cylindrical gears. Gear reducers. Couplings. Flexible mechanical elements.

Basic Bibliography

Norton, R. L. Machine Design: An Integrated Approach. 5th ed. Porto Alegre: Bookman, 2004. ISBN 978-85-36302-73-7.

Shigley, J. E.; Mischke, C. R.; Budynas, R. G. Shigley's Mechanical Engineering Design. 8th ed. Porto Alegre: Bookman, 2011. ISBN 978-85-63308-20-7.
Juvinall, R. C.; Marshek, K. M. Fundamentals of Machine Component Design. 2nd ed. Wiley, 1991. ISBN 978-04-71529-89-7.

Supplementary Bibliography

Cunha, L. B. Machine Elements. Rio de Janeiro: LTC, 2005. ISBN 978-85-21614-55-5.
Niemann, G. Machine Elements. Vol. 1–3. São Paulo: Edgard Blucher, 1971.
Reshetov, D. N. Machine Construction Atlas. 2nd ed. Rio de Janeiro: Hemus, 1998. ISBN 978-8528903-42-3.

Course: EMB5117 – Introduction to the Finite Element Method

Semester: 7
Workload (credits – class hours): 4 credits – 72h
Prerequisite: EMB5104 – Mechanics of Solids II

Syllabus

CAE systems (Computer Aided Engineering). Stiffness matrix and system equation assembly. One- and two-dimensional linear problems. Degrees of freedom and element interpolation functions. Material constitutive models. Stress analysis and convergence curve. Isoparametric elements. Numerical integration. Application using commercial software.

Basic Bibliography

Fish, J.; Belytschko, T. A First Course in Finite Elements. LTC, 2009.
Zienkiewicz, O. C.; Taylor, R. L.; Zhu, J. Z. The Finite Element Method: Its Basis and Fundamentals. 6th ed. Butterworth-Heinemann, 2005.
Alves Filho, A. Finite Elements: The Basis of CAE Technology – Matrix Analysis. 5th ed. São Paulo: Érica, 2007. ISBN 9788571947412.

Supplementary Bibliography

Cook, R. D.; Malkus, D. S.; Plesha, M. E. Concepts and Applications of Finite Element Analysis. 3rd ed. Wiley, 1989. ISBN 0471847887.
Bathe, K. J. Finite Element Procedures. Prentice Hall, 1995. ISBN 978-0-9790049-0-2.
Zienkiewicz, O. C.; Taylor, R. L. The Finite Element Method for Solid and Structural Mechanics. 6th ed. Butterworth-Heinemann, 2005. ISBN 0-7506-5055-9.
Hughes, T. J. R. The Finite Element Method: Linear Static and Dynamic Analysis. Dover, 2000.
Reddy, J. N. An Introduction to the Finite Element Method. McGraw-Hill, 2005. ISBN 978-0072466850.

Course: EMB5304 – Internal Combustion Engines I

Semester: 7
Workload (credits – class hours): 4 credits – 72h
Prerequisites: EMB5103 – Heat Transfer I; EMB5431 – Combustion Fundamentals

Syllabus

Fundamental concepts, definition, classification, and typical applications of ICEs. Ideal and real thermodynamic cycles (theoretical and indicated). Parameters and characteristic curves of ICEs (engine performance). Fuel supply systems and distribution systems. Gas charging and cylinder gas exchange – supercharging. Combustion in spark-ignition engines. Combustion in compression-ignition engines. Lubrication and cooling systems in engines. Fossil fuels and alternative fuels. Production and mitigation of pollutant emissions.

Basic Bibliography

Heywood, J. B. Internal Combustion Engine Fundamentals. 1st ed. New York: McGraw-Hill, 1988. ISBN 978-00-70286-37-5.
Martins, J. Internal Combustion Engines. 3rd ed. Porto: Publindústria, 2011. ISBN 978-97-28953-85-0.

Chollet, H. M. Professional Practical Course for Automobile Mechanics: The Engine. Curitiba: Hemus, 2002. ISBN 978-85-28900-36-1.

Supplementary Bibliography

Chollet, H. M. Professional Practical Course for Automobile Mechanics: The Vehicle. Curitiba: Hemus, 2002. ISBN 978-85-28900-37-8.
Johnson, J. H. SI Engine Emissions. SAE International, 2005. ISBN 978-07-68016-58-1.
Stone, R. Introduction to Internal Combustion Engines. 3rd ed. SAE/Macmillan Press, 1999. ISBN 978-07-68004-95-3.
Bosch, R. Automotive Handbook. 8th ed. SAE, 2011. ISBN 978-11-19975-56-4.
Merker, G. P.; Schwarz, C.; Teichmann, R. (Eds.). Combustion Engines Development – Mixture Formation, Combustion, Emissions and Simulation. Springer, 2012. ISBN 978-3-642-02951-6.

Course: EMB5056 – Ergonomics and Safety

Semester: 7
Workload (credits – class hours): 2 credits – 36h
Prerequisites: —

Syllabus

Basic concepts. Work physiology. Anthropometry and biomechanics. Cognitive processes. Information devices. Perception and information processing. Handling and controls. Ergonomic analysis methodologies. Product ergonomics. Environmental variables: lighting, noise, vibration, temperature. Ergonomic analysis of work. Occupational safety.

Basic Bibliography

Kroemer, K. H. E.; Grandjean, E. Ergonomics Manual: Adapting Work to Man. 5th ed. Porto Alegre: Bookman, 2005. ISBN 9788536304373.
Dul, J.; Weerdmeester, B. Practical Ergonomics. 2nd ed. São Paulo: Edgard Blucher, 2004. ISBN 978-8521206-42-2.
Iida, I. Ergonomics: Design and Production. 2nd ed. São Paulo: Edgard Blucher, 2005. ISBN 978-85-2120354-4.

Supplementary Bibliography

Cybis, W.; Betiol, A. H.; Faust, R. Ergonomics and Usability: Knowledge, Methods and Applications. São Paulo: Novatec, 2015. ISBN 9788575224595.
Guérin, F. et al. Understanding Work to Transform It: The Practice of Ergonomics. São Paulo: Edgard Blucher, 2001. ISBN 8521202970.
Betiol, M. I. S.; Daniellou, F. Ergonomics in Search of Its Principles: Epistemological Debates. São Paulo: Edgard Blucher, 2004. ISBN 8521203500.
Másculo, F. S.; Vidal, M. C. Ergonomics: Adequate and Efficient Work. Rio de Janeiro: Campus, 2011. ISBN 978-85-35238-02-0.
Amorim, C. et al. Ergonomics and Technology [in focus]. São Paulo: Blucher, [201-]. Available at: https://doi.org/10.5151/9786555500455

Course: EMB5341 – Materials and Processes of Vehicle Construction I

Semester: 7
Workload (credits – class hours): 2 credits – 36h
Prerequisite: EMB5102 – Materials Science

Syllabus

Classification of steels used in vehicle construction. Advanced High Strength Steels (AHSS): chemical composition and strengthening mechanisms. Processing of AHSS and its influence on microstructure and mechanical properties: cold rolling, annealing, and surface treatments. Sheet forming processes: cold and hot stamping. Formability and weldability of AHSS. Fundamentals of the Tailored Blank and hydroforming processes for sheets and tubes. Forging and heat treatments of automotive steel components. Criteria for selecting manufacturing processes of automotive components. Manufacturing planning: process sheets and operation sheets.

Basic Bibliography

Helman, H.; Cetlin, P. R. Fundamentals of Metal Forming. 2nd ed. São Paulo: Artliber, 2015. ISBN 978-85-88098-28-2.
Schaeffer, L. Metal Forming: Applied Calculations in Manufacturing Processes. Porto Alegre: Imprensa Livre, 2007. ISBN 978-85-76970-73-6.
Meyers, M. A.; Chawla, K. K. Principles of Mechanical Metallurgy. São Paulo: Edgard Blücher, 1982. ISBN 978-99-91031-44-6.

Supplementary Bibliography

Dieter, J. E. Mechanical Metallurgy. 2nd ed. Rio de Janeiro: Guanabara Dois, 1981.
Silva, A. L. V. C. e; Mei, P. R. Steels and Special Alloys. 3rd ed. São Paulo: Edgard Blucher, 2010.
Callister, W. D. Jr.; Rethwisch, D. G. Materials Science and Engineering: An Introduction. 8th ed. Rio de Janeiro: LTC, 2012.
Qureshi, H. A. A. Manufacturing Processes. UFSC, 2011.
World Auto Steels. Advanced High Strength Steels (AHSS). 2020. Available at: https://www.worldautosteel.org

Course: EMB5320 – Entrepreneurship and Innovation

Semester: 7
Workload (credits – class hours): 2 credits – 36h
Prerequisites: EMB5961 – Engineering Economics; EMB5059 – Project Methodology; EMB5120 – Management and Organization

Syllabus

Concept of innovation. Types of innovation. Innovation strategies. Innovation as an organizational process. Mechanisms for fostering and cooperating in research and development. Entrepreneurship. Characteristics, types, and skills of entrepreneurs. Business Plan – stages, processes, and preparation.

Basic Bibliography

Coral, E.; Ogliari, A.; Abreu, A. F. Integrated Innovation Management: Strategy, Organization, and Product Development. São Paulo: Atlas, 2008. ISBN 978-85-22449-76-7.
Dornelas, J. Entrepreneurship – Turning Ideas into Business. 5th ed. Rio de Janeiro: LTC, 2014. ISBN 978-85-21624-97-4.
Osterwalder, A. Business Model Generation. São Paulo: Alta Books, 2011. ISBN 978-85-76085-50-8.

Supplementary Bibliography

Pavani Jr., O.; Scucuglia, R. Business Process Mapping and Management – BPM. São Paulo: Books, 2011.
Monteiro Jr., J. G. Creativity and Innovation. São Paulo: Pearson, 2011.
Lapolli, E. M.; Franzoni, A. M. B.; Souza, V. A. B. Entrepreneurial Experiences: The Practice of Entrepreneurship in Organizations. Florianópolis: Pandion, 2012.
Tidd, J.; Pavitt, K.; Bessant, J. Innovation Management. 3rd ed. Porto Alegre: Bookman, 2008.
Casarotto Filho, N.; Kopittke, B. H. Investment Analysis. São Paulo: Atlas, 2011.
Lezana, A. G. R. Entrepreneurship and the Organizational Life Cycle. UFSC.

Course: EMB5327 – Hydraulic, Pneumatic Actuation and Brakes

Semester: 7
Workload (credits – class hours): 3 credits – 54h
Prerequisite: EMB5316 – Vehicle Dynamics

Syllabus

Introduction to hydraulic and pneumatic systems: components, modeling, and control. Hydraulic and pneumatic brake systems. Disc and drum brakes. ABS brakes. Brake system design.

Basic Bibliography

Von Linsingen, I. Fundamentals of Hydraulic Systems. 3rd ed. Florianópolis: UFSC Press, 2008. ISBN 978-85-32803-98-6.
Prudente, F. Industrial Pneumatic Automation: Theory and Applications. Rio de Janeiro: LTC, 2013. ISBN 9788521621195.
Heisler, H. Advanced Vehicle Technology. 2nd ed. SAE International, 2002. ISBN 978-07-68010-71-8.

Supplementary Bibliography

Fialho, A. B. Hydraulic Automation: Design, Sizing, and Circuit Analysis. 5th ed. São Paulo: Érica, 2007.
Bollmann, A. Fundamentals of Industrial Pneutronic Automation: Electro-Pneumatic Binary Control Design. São Paulo: ABHP, 1997.
Bill, K. B.; Breuer, B. J. Brake Technology Handbook. SAE International, 2008. ISBN 978-07-68017-87-8.
Limpert, R. Brake Design and Safety. 3rd ed. SAE International, 2011. ISBN 978-07-68034-38-7.
Bosch, R. Automotive Handbook. São Paulo: Edgard Blucher, 2005. ISBN 978-85-2120378-0.

Course: EMB5392 – Heat Treatment Technology Applied to Automotive Components

Semester: 7

Workload (credits – class hours): 4 credits – 72h

Prerequisite: EMB5102 – Manufacturing Processes

Syllabus

Fundamentals of heat treatment theory: phase transformations, relationship between microstructure and mechanical properties of treated products. Main heat treatment processes and parameter control methods. Equipment and devices used in heat treatment practice. Surface finishing processes for treated parts. Methods for solving problems associated with heat treatment technologies. Experimental design applied to heat treatment. Technical standards for heat treatment practice. Destructive and non-destructive testing used in process qualification and product quality. Stress analysis from heat treatment. Cost analysis of the process. Practice in industrial laboratory.

Basic Bibliography

Colpaert, H. Metallography of Common Steel Products. 4th ed. São Paulo: Edgard Blucher, 2008.
Chiaverini, V. Steels and Cast Irons: General Characteristics, Heat Treatments, Main Types. 7th ed. São Paulo: ABM, 1996.
Crisostimo, A. L. University Extension and Knowledge Production. Guarapuava: Unicentro, 2017.

Supplementary Bibliography

Callister, W. D. Jr.; Rethwisch, D. G. Materials Science and Engineering: An Introduction. 8th ed. Rio de Janeiro: LTC, 2012.
Duarte, I. R.; Silva, O. C. A. Processing of Cast Aluminum-Silicon Alloys. Nova Letra, 2009.
Garcia, A. Solidification: Fundamentals and Applications. 2nd ed. UNICAMP, 2007.
Freitas, P. S. Heat Treatment of Metals. SENAI-SP, 2017.
Freitas, P. S. Heat Treatment: From Theory to Practice. SENAI-SP, 2014.
Novikov, I. Theory of Metal Heat Treatments. UFRJ, 1994.
ASTM. Metals Handbook – Heat Treating, Vol. 4. ASM International.

Course: EMB5303 – Vehicle Systems I: Chassis, Suspension, and Steering

Semester: 8

Workload (credits – class hours): 4 credits – 72h

Prerequisites: EMB5119 – Machine Elements; EMB5316 – Vehicle Dynamics

Syllabus

Main components of chassis and bodies; Types of chassis; Chassis design; Types of steering systems; Steering system design; Types of suspension systems; Suspension system design.

Basic Bibliography

Genta, G.; Morello, L. The Automotive Chassis. Springer, 2009.
Morello, L.; Rossini, L. R.; Pia, G.; Tonoli, A. The Automotive Body: Volume I – System Design. Springer, 2011.
Jazar, R. N. Vehicle Dynamics: Theory and Application. Springer, 2008.

Supplementary Bibliography

Pacejka, H. B. Tire and Vehicle Dynamics. 3rd ed. Butterworth-Heinemann, 2012.
Seiffert, U. W.; Braess, H. H. Handbook of Automotive Engineering. SAE International, 2005.
Gillespie, T. D. Fundamentals of Vehicle Dynamics. SAE, 1992.
Crolla, D. A. Automotive Engineering. Elsevier, 2009.
Genta, G.; Morello, L. The Automotive Chassis: System Design, Vol. 2. Springer, 2009.

Course: EMB5324 – Mold and Die Design for the Automotive Industry

Semester: 8
Workload (credits – class hours): 2 credits – 36h
Prerequisites: EMB5012 – Technical Drawing; EMB5102 – Manufacturing Processes

Syllabus

Main types, components, and classification of molds and dies for the automotive industry; Basic principles of mold and die design aimed at improving automotive components; Maintenance, materials, heat and surface treatments used in tooling.

Basic Bibliography

Harada, J. Molds for Thermoplastic Injection: Design and Basic Principles. São Paulo: Artliber, 2004.
Brito, O. Techniques and Applications of Cutting Dies. 3rd ed. São Paulo: Hemus, 2004.
Brito, O. Forming Dies: Sheet Bending, Drawing, Technical Developments. São Paulo: Hemus, 2005.

Supplementary Bibliography

Glanvill, A. B.; Denton, E. N. Injection Molds: Basic Principles and Designs. 2nd ed. São Paulo: E. Blucher, 1982. 309 p. ISBN 978-85-21202-60-8.
Harada, J.; Ueki, M. M. Thermoplastic Injection. 1st ed. São Paulo: Artliber, 2012. 250 p. ISBN 978-85-88098-18-3.
Rosato, M. G.; Rosato, D. V. (eds.). Plastics Design Handbook. 1st ed. New York, NY: Springer US, 2001. xix, 680 p. 125 ill. ISBN 9781461513995. Available at: https://doi.org/10.1007/978-1-4615-1399-5
Sacchelli, C. M. Systematization of the Integrated Development Process of Thermoplastic Injection Molds. Florianópolis, 2007. xxi, 284 f. Doctoral Thesis – Federal University of Santa Catarina, Technological Center, Graduate Program in Mechanical Engineering. Available at: http://www.tede.ufsc.br/teses/PEMC1021-T.pdf
Schaeffer, L. Metal Forming. 3rd ed. rev. Porto Alegre: Imprensa Livre, 2009. 167 p. ISBN 8586647136.

Course: EMB5342 – Welding Processes for Automotive Engineering

Semester: 8
Credits / Hours: 4 / 72
Prerequisites: EMB5022, EMB5108

Syllabus

Classification of joining processes. Fundamentals of joining processes: terminology, types of joints and bevels, welding positions. Joining by forming: bending, clinching, riveting. Fundamentals of welding metallurgy. Physics of the electric arc and power sources. Arc welding processes: Shielded Metal Arc Welding (SMAW), MIG/MAG, TIG, and Plasma. Oxyacetylene welding and oxyfuel cutting. Resistance welding: spot, projection, seam, and flash. Laser welding. Friction welding. Brazing. Applications in automotive engineering.

Basic Bibliography

Marques, P. V.; Modenesi, P. J.; Bracarense, A. Q. Welding: Fundamentals and Technology. Belo Horizonte: UFMG, 2005.
Wainer, E.; Brandi, S. D.; Mello, F. D. H. Welding: Processes and Metallurgy. São Paulo: Blucher, 2011.
Machado, I. G. Welding and Related Techniques: Processes. Porto Alegre, 1996.

Supplementary Bibliography

Grote, K.-H.; Antonsson, E. K. (eds.). Springer Handbook of Mechanical Engineering. Berlin: Springer, 2009. ISBN 9783540307389. Available at: https://doi.org/10.1007/978-3-540-30738-9.
Associação Brasileira de Metais. Welding Course. 8th ed., 1974.
Singh, R. P. Applied Welding Engineering: Processes, Codes and Standards. 2nd ed. Amsterdam: Elsevier, 2016. ISBN 9780128041765.
Connor, L. P. Welding Handbook. 8th ed. Miami: American Welding Society, 1987. 3 v. ISBN 0871712814.
Okumura, T.; Taniguchi, C. Welding Engineering and Applications. Rio de Janeiro: LTC, 1982. ISBN 8521602340.

Course: EMB5356 – Vehicle Construction Materials and Processes II

Semester: 8
Credits / Hours: 2 / 36
Prerequisites: EMB5022

Syllabus

Physicochemical properties of polymers. Rheological properties of molten polymers. Processing of thermoplastic materials: extrusion, injection molding, blow molding, thermoforming, and rotational molding. Processing of thermosetting materials: manual, spray-up, resin transfer molding, SMC, BMC.

Basic Bibliography

Manrich, S. Processing of Thermoplastics: Single Screw, Extrusion and Dies, Injection and Molds. São Paulo: Artliber, 2005. ISBN 978-85-88098-30-5.
Bretas, R. E. S. Rheology of Molten Polymers. 2nd ed. São Paulo: UFSCAR, 2005. ISBN 978-85-76000-48-8.
Canevarolo Jr., S. V. Polymer Science. 2nd ed. São Paulo: Artliber, 2002. ISBN 978-8588098-10-7.

Supplementary Bibliography

Marinucci, G. Polymeric Composite Materials. São Paulo: Artliber, 2011. ISBN 978-85-88098-63-3.
Harada, J.; Ueki, M. M. Thermoplastic Injection. São Paulo: Artliber, 2012. ISBN 978-85-88098-18-3.
Peters, S. T. Handbook of Composites. 2nd ed. London: Chapman & Hall, 1998. ISBN 978-04-12540-20-2.
Rosato, D. V.; Rosato, P. E. Plastics Processing Data Handbook. 2nd ed. London: Chapman & Hall, 1997. ISBN 978-04-12801-90-7.
Rubin, I. I. Injection Molding: Theory and Practice. New York: Wiley, 1972. ISBN 97804-71744-45-0.
Stevens, M. J.; Covas, J. A. Extruder Principles and Operations. 2nd ed. London: Chapman & Hall, 1995. ISBN 978-04-12635-90-8.
Crawford, R. J.; Throne, J. L. Rotational Molding Technology. New York: Plastics Design Library, 2001. ISBN 978-18-84207-85-3.
Throne, J. L. Technology of Thermoforming. Cincinnati: Hanser Gardner, 1996. ISBN 978-15-69901-98-4.

Course: EMB5044 – Final Course Project Planning

Semester: 8
Credits / Hours: 2 / 36
Prerequisites: 2592 h/a

Syllabus

Research and the scientific method. Problem formulation. Hypothesis construction. Types and characteristics of research. Development of research projects. At this stage, students will prepare their Final Course Project proposal, including: title, theme, problem statement, hypotheses, objectives, justification, theoretical framework, methodology, expected results, schedule, and main references.

Basic Bibliography

Marconi, M. A.; Lakatos, E. M. Research Techniques. 7th ed. São Paulo: Atlas, 2013. ISBN 978-85-224-5152-4.

Martins, D. S.; Zilberknop, L. S. Instrumental Portuguese. 29th ed. São Paulo: Atlas, 2010. ISBN 978-85-224-5722-9.

Savioli, F. P.; Fiorin, J. L. Text Lessons: Reading and Writing. 5th ed. São Paulo: Ática, 2006. ISBN 978-85-08-10594-6.

Supplementary Bibliography

Cervo, A. L.; Bervian, P. A.; Silva, R. Scientific Methodology. 6th ed. São Paulo: Pearson Prentice Hall, 2007. ISBN 978-85-7605-047-6.

Gil, A. C. How to Prepare Research Projects. 5th ed. São Paulo: Atlas, 2010. ISBN 978-85-224-5823-3.

Lakatos, E. M.; Marconi, M. A. Fundamentals of Scientific Methodology. 7th ed. São Paulo: Atlas, 2010. ISBN 978-85-22457-58-8.

Oliveira, J. P. M.; Motta, C. A. P. How to Write Technical Texts. 2nd ed. São Paulo: Cengage Learning, 2015. ISBN 978-85-221-12-3-6.

Severino, A. J. Methodology of Scientific Work. 23rd ed. São Paulo: Cortez, 2007. ISBN 978-85-249-1311-2.

Course: EMB5329 – Transmissions

Semester: 8

Credits / Hours: 3 / 54

Prerequisite: EMB5119

Syllabus

Introduction to the vehicle powertrain. Types of transmission systems: manual and automatic. Actuation and control systems, components and operation. Transmission system design.

Basic Bibliography

Mashadi, B.; Crolla, D. Vehicle Powertrain Systems. Chichester: Wiley, 2012. ISBN 9780470666029.

Genta, G.; Morello, L. The Automotive Chassis: Volume 1: Components Design. Dordrecht: Springer, 2009. ISBN 9781402086762.

Wong, J. Y. Theory of Ground Vehicles. 3rd ed. New York: Wiley, 2001. ISBN 0471354619.

Supplementary Bibliography

Crolla, D. A. Automotive Engineering: Powertrain, Chassis System and Vehicle Body. Amsterdam: Elsevier, 2009. ISBN 9781856175777.

Heisler, H. Advanced Vehicle Technology. 2nd ed. Warrendale: SAE, 2002. ISBN 978-07-68010-71-8.

Naunheimer, H.; Bertsche, B.; Ryborz, J.; Novak, W. Automotive Transmissions: Fundamentals, Selection, Design and Application. 2nd ed. Berlin: Springer, 2011. ISBN 9783642162145.

Genta, G.; Morello, L. The Automotive Chassis: Volume 2: System Design. Dordrecht: Springer, 2009. ISBN 9781402086755.

Bosch, R. Automotive Handbook. São Paulo: Blucher, 2005. ISBN 978-85-2120378-0.

Course: EMB5350 – Statistical Quality Control

Semester: 8

Credits / Hours: 4 / 72

Prerequisite: EMB5057

Syllabus

Fundamentals and statistical methods applicable to quality control and continuous improvement. Statistical process control and capability analysis: understanding variation, control charts for variables and attributes, capability indices, control charts for specific applications. Measurement system analysis: impact of measurement system variation on product inspection and process control, measures of location and variation, graphical evaluation. Sampling plans in attribute inspection. Design of experiments: general guidelines, factorial design, statistical analysis, residual analysis.

Basic Bibliography

Montgomery, D. C. Introduction to Statistical Quality Control. 4th ed. Rio de Janeiro: LTC, 2004. ISBN 9788521614005.

Costa, A. F. B.; Epprecht, E. K.; Carpinetti, L. C. R. Statistical Quality Control. 2nd ed. São Paulo: Atlas, 2014. ISBN 9788522441563.

Carvalho, M. M.; Paladini, E. P. Quality Management: Theory and Cases. 2nd ed. Rio de Janeiro: Elsevier, 2012. ISBN 9788535248876.

Supplementary Bibliography

Devore, J. L. Probability and Statistics for Engineering and the Sciences. São Paulo: Cengage, 2015. ISBN 9788522111831.

AIAG. CEP – Fundamentals of Statistical Process Control. 2nd American ed. AIAG, 2005.

AIAG. MSA – Measurement System Analysis. 4th American ed. AIAG, 2010.

Allen, T. T. Introduction to Engineering Statistics and Lean Sigma. London: Springer, 2010. ISBN 9781849960007.

Montgomery, D. C.; Runger, G. C. Applied Statistics and Probability for Engineers. 5th ed. Rio de Janeiro: LTC, 2012. ISBN 9788521619024.

Course: EMB5100 – Project: Entrepreneurship and Innovation

Semester: 8

Credits / Hours: 4 / 72

Prerequisite: EMB5320

Syllabus

Product, service, and business conception process. Application of management concepts and tools. Application of models for the development of new businesses.

Basic Bibliography

Rozenfeld, H.; Forcellini, F. A.; Amaral, D. C.; Toledo, J. C.; Silva, S. L.; Alliprandini, D. H.; Scalice, R. K. Product Development Management: A Reference for Process Improvement. São Paulo: Saraiva, 2006. ISBN 8502054465.

Dornelas, J. C. A. Entrepreneurship: Turning Ideas into Business. 3rd ed. Rio de Janeiro: Campus, 2008. ISBN 9788535232707.

Casarotto Filho, N.; Kopittke, B. H. Investment Analysis: Financial Mathematics, Economic Engineering, Decision-Making, Business Strategy. 11th ed. São Paulo: Atlas, 2010. ISBN 9788522457892.

Supplementary Bibliography

Sobral, F.; Peci, A. Administration: Theory and Practice in the Brazilian Context. 2nd ed. São Paulo: Pearson, 2013. ISBN 9788581430850.

Slack, N.; Stuart, C.; Johnson, R. Production Management. São Paulo: Atlas, 2009. ISBN 9788522453535.

Coral, E.; Ogliari, A.; Abreu, A. F. Integrated Innovation Management: Strategy, Organization, and Product Development. São Paulo: Atlas, 2008. ISBN 9788522449767.

Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, K.-H. Engineering Design: A Systematic Approach. São Paulo: Blucher, 2005.

Osterwalder, A. Business Model Generation. São Paulo: Alta Books, 2011. ISBN 9788576085508.

Course: EMB5370 – Complementary Activities
Semester: 8
Credits / Hours: 6 / 108
Prerequisite: 2400 h/a
Syllabus
Validation of complementary activities. These integrate the curriculum and aim to enrich the teaching-learning process, emphasizing the enhancement of students' social and professional development.

Basic Bibliography
Not applicable.

Course: EMB5045 – Final Graduation Project
Semester: 9
Credits / Hours: 4 / 72
Prerequisite: EMB5044
Syllabus
Consolidation of knowledge acquired throughout the program, aiming to develop the student's ability to conceive, implement, and/or evaluate solutions in situations related to their field of study.

Basic Bibliography
To be defined according to the specific project undertaken.

Course: EMB5317 – Vehicle Aerodynamics
Semester: 9
Credits / Hours: 4 / 72
Prerequisite: EMB5123, EMB5316
Syllabus
Basic principles of aerodynamics. History of aerodynamic development in automobiles. Aerodynamics and shape (influence of shape on aerodynamic forces). Wind tunnels for automotive applications. Aerodynamics of passenger vehicles. Aerodynamics of high-performance vehicles. Aerodynamics of commercial vehicles. Aerodynamics and heat transfer. Preliminary project – Computational Fluid Dynamics (CFD) simulation.

Basic Bibliography
Schuetz, T. Aerodynamics of Road Vehicles. 5th ed. Warrendale: SAE, 2015. ISBN 9780768079777.
Milliken, W. F.; Milliken, D. L. Race Car Vehicle Dynamics. Warrendale: SAE, 1995. ISBN 9781560915263.
Simon, M.; Elizalde, P. Aerodinámica del Automóvil de Competición. 2nd ed. Barcelona: CEA, 2005. ISBN 9788432911675.

Supplementary Bibliography
Milliken, W. F.; Milliken, D. L. Race Car Vehicle Dynamics – Problems, Answers and Experiments. Warrendale: SAE, 2003. ISBN 9780768011272.
White, F. M. Fluid Mechanics. 7th ed. New York: McGraw-Hill, 2010. ISBN 9780077422417.
Çengel, Y. A.; Cimbala, J. M. Fluid Mechanics: Fundamentals and Applications. São Paulo: McGraw-Hill, 2008. ISBN 9788586804588.
Munson, B. R.; Young, D. F.; Okiishi, T. H. Fundamentals of Fluid Mechanics. São Paulo: Blucher, 2004. ISBN 9788521203438.
Hucho, W.-H. (Ed.). Aerodynamics of Road Vehicles – From Fluid Mechanics to Vehicle Engineering. 4th ed. Warrendale: SAE, 1998. ISBN 0768000297.

Course: EMB5326 – Vehicle Product Development
Semester: 9
Credits / Hours: 3 / 54

Prerequisite: EMB5303, EMB5329, EMB5327

Syllabus

Product design applied to vehicle development. Preliminary design, detailed design, testing, and validation of vehicle product design.

Basic Bibliography

Wong, J. Y. Theory of Ground Vehicles. 3rd ed. New York: Wiley, 2001. ISBN 9780471354611.
Genta, G.; Morello, L. The Automotive Chassis: System Design. Vol. 2. New York: Springer, 2009. ISBN 9781402086731.
Crolla, D. Automotive Engineering: Powertrain, Chassis System and Vehicle Body. Amsterdam: Elsevier, 2009. ISBN 9781856175777.

Supplementary Bibliography

Heißing, B.; Ersoy, M. (Eds.). Chassis Handbook: Fundamentals, Driving Dynamics, Components, Mechatronics, Perspectives. Wiesbaden: Vieweg+Teubner, 2011. ISBN 9783834897893.
Morello, L.; Rossini, L. R.; Pia, G.; Tonoli, A. The Automotive Body: Volume I: Components Design. Dordrecht: Springer, 2011. ISBN 9789400705135.
Genta, G.; Morello, L. The Automotive Chassis: Volume 1: Components Design. Dordrecht: Springer, 2009. ISBN 9781402086762.
Weber, J. Automotive Development Processes: Processes for Successful Customer-Oriented Vehicle Development. Berlin: Springer, 2009. ISBN 9783642012532.
SAE International. Design Innovations in Electric and Hybrid Electric Vehicles. Warrendale: SAE, 1995. ISBN 1560916397.

Course: EMB5360 – Introduction to Electric Vehicles

Semester: 9
Credits / Hours: 4 / 72
Prerequisite: EMB5108

Syllabus

Introduction to the electric car. The electric powertrain. Fundamentals of electric machines. Fundamentals of power electronics. Energy storage and conversion systems. Introduction to hybrid vehicles.

Basic Bibliography

Rashid, M. H. Power Electronics: Devices, Circuits and Applications. ISBN 9788543005942.
Hayes, J. G.; Goodarzi, G. A. Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles. Wiley, 2015. ISBN 1119063647.
Ehsani, M.; Gao, Y.; Longo, S.; Ebrahimi, K. Modern Electric, Hybrid Electric and Fuel Cell Vehicles. 3rd ed. CRC Press, 2018. ISBN 0367137461.

Supplementary Bibliography

Santos, M. M. D. Veículos Elétricos e Híbridos: Fundamentos, Características e Aplicações. São Paulo: Érica, 2012. ISBN 8536532815.
Husain, I. Electric and Hybrid Vehicles: Design Fundamentals. 3rd ed. CRC Press, 2021. ISBN 0367693933.
Rahn, C. D.; Wang, C.-Y. Battery Systems Engineering. Wiley, 2013. ISBN 9781119979500.
Denton, T. Electric and Hybrid Vehicles. São Paulo: Blucher, 2010. ISBN 8521213018.
Mohan, N. Electric Machines and Drives: A First Course. São Paulo: LTC, 2012. ISBN 8521627629.

Course: EMB5386 – Refrigeration and Air Conditioning

Semester: 9
Credits / Hours: 3 / 54
Prerequisite: EMB5009, EMB5017

Syllabus

Theoretical and environmental aspects. Single-stage systems, Carnot refrigeration cycle, standard refrigeration cycle, cycles with subcooling and superheating, cycle with intermediate heat

exchanger. Multi-stage systems. Fixed expansion devices, expansion valves, capillary tubes, short tubes. Variable expansion devices: float-type expansion valves, pressure-controlled expansion valves, thermostatic expansion valves, electric valves. Reciprocating compressors, compression process, volumetric efficiency, capacity control methods. Psychrometry and psychrometric processes. Air conditioning and automotive refrigeration.

Basic Bibliography

Stoecker, W. F.; Jones, J. W. Refrigeração e Ar Condicionado. McGraw Hill do Brasil, São Paulo, 1985.

Dossat, R. J. Princípios da Refrigeração. 4th ed. Prentice Hall, New Jersey, 1997.

Çengel, Y. A.; Boles, M. A. Thermodynamics. 5th ed. São Paulo: McGraw-Hill, 2006. ISBN 8586804665.

Supplementary Bibliography

Ananthanarayanan, P. N. Basic Refrigeration and Air Conditioning. 3rd ed. McGraw Hill, New Delhi, 2005.

Arora, C. P. Refrigeration and Air Conditioning. 3rd ed. Tata McGraw-Hill, New Delhi, 1986.

Dinçer, I.; Kanoglu, M. Refrigeration Systems and Applications. 2nd ed. Wiley, 2010.

Jones, W. P. Air Conditioning Engineering. 5th ed. Butterworth-Heinemann, Oxford, 2003.

Kuehn, T. H.; Ramsey, J. W.; Threlkeld, J. L. Thermal Environmental Engineering. Prentice Hall, 1998.

Course: EMB5391 – Transforming Society with Vehicles

Semester: 9

Credits / Hours: 4 / 72

Prerequisite: EMB5303, EMB5329, EMB5327

Syllabus

Guidelines for extension activities. Diagnostic analysis in communities interested in vehicles. Development of digital content in the field of vehicle systems. Organization of thematic seminars for institutional dissemination about vehicle systems and associated technologies.

Basic Bibliography

Crisostimo, A. L.; Silveira, R. M. C. F. A Extensão Universitária e a Produção do Conhecimento. Guarapuava: Unicentro, 2017.

Genta, G.; Morello, L. The Automotive Chassis: Volume 1: Components Design. Springer, 2009. ISBN 9781402086762.

Genta, G.; Morello, L. The Automotive Chassis: System Design. Springer, 2009. ISBN 9781402086731.

Supplementary Bibliography

Assis, E. C. P.; Moura, C. A. C.; Sandoval, I. M. B. Humanidades Digitais: Leitura e Tecnologia. Florianópolis: NUPPIL/UFSC, 2014. ISBN 9788583880226.

Palloff, R. M.; Pratt, K. Lessons from the Virtual Classroom. Rio de Janeiro: Penso, 2015. ISBN 9788584290208.

Isaacson, W. The Innovators: How a Group of Hackers, Geniuses, and Geeks Created the Digital Revolution. São Paulo: Companhia das Letras, 2014. ISBN 9788535925029.

Freire, P. Extensão ou Comunicação. Rio de Janeiro: Paz e Terra, 2001. ISBN 8521904274.

Wong, J. Y. Theory of Ground Vehicles. 3rd ed. Wiley, 2001. ISBN 9780471354611.

Course: EMB5046 – Mandatory Internship

Semester: 10

Credits / Hours: 12 / 216

Prerequisite: 3496 hours completed

Syllabus

Practical experience in industries, research institutions, or companies that use the technical content of the program. Hands-on training through the application of acquired technical knowledge. Development or improvement of professional and interpersonal skills.

Basic Bibliography

To be defined according to the specific work undertaken.

Course: EMB5390 – Extension Activities

Semester: 10

Credits / Hours: 12 / 216

Prerequisite: —

Syllabus

Validation of extension activities in compliance with extension curricularization.

Basic Bibliography

No specific bibliography.

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Brasil. (05 de Outubro de 1988). Fonte: CONSTITUIÇÃO DA REPÚBLICA FEDERATIVA DO BRASIL DE 1988: http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

Brasil. (20 de Dezembro de 1996). Fonte: LEI Nº 9.394: http://www.planalto.gov.br/ccivil_03/leis/l9394.htm

Brasil. (27 de Abril de 1999). Fonte: LEI No 9.795, DE 27 DE ABRIL DE 1999: http://www.planalto.gov.br/ccivil_03/leis/l9795.htm

Brasil. (25 de Junho de 2002). Fonte: DECRETO Nº 4.281, DE 25 DE JUNHO DE 2002: http://www.planalto.gov.br/ccivil_03/decreto/2002/d4281.htm

Brasil. (22 de Dezembro de 2005). Fonte: DECRETO Nº 5.626, DE 22 DE DEZEMBRO DE 2005.

Brasil. (10 de Março de 2008). Fonte: LEI Nº 11.645: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2008/lei/l11645.htm

Brasil. (11 de Novembro de 2009). Fonte: LEI Nº 12.089: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l12089.htm

Brasil. (18 de Novembro de 2011). Fonte: LEI Nº 12.527: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/lei/l12527.htm

Brasil. (2015). Fonte: PLANO NACIONAL DE EDUCAÇÃO PNE 2014-2024: Linha de Base: http://portal.inep.gov.br/documents/186968/485745/Plano+Nacional+de+Educa%C3%A7%C3%A3o+PNE+2014-2024++Linha+de+Base/c2dd0faa-7227-40ee-a520-12c6fc77700f?version=1.1

Brasil. (06 de Outubro de 2015). Fonte: LEI Nº 13.168: http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2015/lei/l13168.htm

Brasil. (06 de Julho de 2015). Fonte: LEI Nº 13.146: http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2015/lei/l13146.htm

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Centro Tecnológico de Joinville. (29 de Setembro de 2017). Fonte: Regulamento de estágios dos cursos de graduação do CTJ: https://automotiva.paginas.ufsc.br/files/2018/06/Regulamento-Est%C3%A1gios-CTJ-UFSC-2017-_29_09_2017.pdf

CNE. (17 de Junho de 2004). Fonte: RESOLUÇÃO Nº 1, DE 17 DE JUNHO DE 2004: http://portal.mec.gov.br/cne/arquivos/pdf/res012004.pdf

CNE. (30 de Maio de 2012). Fonte: RESOLUÇÃO Nº 1, DE 30 DE MAIO DE 2012.

Comissão Nacional de Avaliação da Educação Superior. (17 de junho de 2010). Fonte: Parecer CONAES: http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=6884-parecer-conae-nde4-2010&category_slug=outubro-2010-pdf&Itemid=30192

CONFEA. (29 de Junho de 1973). Fonte: RESOLUÇÃO Nº 218, DE 29 DE JUNHO DE 1973: https://normativos.confea.org.br/downloads/0218-73.pdf

CONFEA. (19 de Abril de 2016). Fonte: RESOLUÇÃO N° 1.073, DE 19 DE ABRIL DE 2016: https://normativos.confea.org.br/downloads/1073-16.pdf

CONFEA. (05 de Junho de 2020). Fonte: Tabela de Títulos Profissionais: https://normativos.confea.org.br/downloads/anexo/0473-02.pdf

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Conselho Universitário. (30 de Setembro de 1997). Fonte: Resolução Nº 17/CUn/97, DE 30 DE SETEMBRO DE 1997: https://estrutura.ufsc.br/legislacao/

CONSELHO UNIVERSITÁRIO. (30 de Novembro de 2004). Fonte: RESOLUÇÃO Nº 018/CUn/2004: https://repositorio.ufsc.br/bitstream/handle/123456789/551/CUn2004Resolucao018.pdf?sequence=1&isAllowed=y

CONSELHO UNIVERSITÁRIO. (25 de Outubro de 2016). Fonte: RESOLUÇÃO NORMATIVA Nº 88/2016/CUn: https://proex.ufsc.br/files/2016/11/Resolu%C3%A7%C3%A3oNormativa_88_Extens%C3%A3o.pdf

CONSELHO UNIVERSITÁRIO. (07 de Junho de 2016). Fonte: RESOLUÇÃO NORMATIVA Nº 73/2016/CUn: http://portal.estagios.ufsc.br/files/2016/06/RN-73_CUn_2016.pdf

CONSELHO UNIVERSITÁRIO. (27 de Fevereiro de 2018). Fonte: RESOLUÇÃO NORMATIVA Nº 117/2018/CUn: https://repositorio.ufsc.br/bitstream/handle/123456789/188226/RN117_Altera%20artigo%20da%20Resolu%C3%A7%C3%A3o%20017CUn1997.pdf?sequence=1&isAllowed=y

DIÁRIO OFICIAL DA UNIÃO. (30 de Março de 2017). Fonte: LEI NO 13.425, DE 30 DE MARÇO DE 2017: https://www.in.gov.br/materia/-/asset_publisher/Kujrw0TZC2Mb/content/id/20137936/do1-2017-03-31-lei-no-13-425-de-30-de-marco-de-2017-20137788

DIÁRIO OFICIAL DA UNIÃO. (06 de Dezembro de 2019). Fonte: PORTARIA Nº 2.117: https://www.in.gov.br/en/web/dou/-/portaria-n-2.117-de-6-de-dezembro-de-2019-232670913

DIÁRIO OFICIAL DA UNIÃO. (29 de Dezembro de 2020). Fonte: RESOLUÇÃO CNE/CES Nº 1: https://www.in.gov.br/en/web/dou/-/resolucao-cne/ces-n-1-de-29-de-dezembro-de-2020-296893578

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Direção Acadêmica. (18 de Setembro de 2013). Fonte: Portaria N.91/2013/DAC/CJ de 18 de setembro de 2013: https://joinville.ufsc.br/files/2013/02/Portaria-091-Constitui%C3%A7%C3%A3o-NDE-Engenharia-Automotiva.pdf

Educação, Ministério da. (26 de Março de 2021). Fonte: RESOLUÇÃO Nº 1, DE 26 DE MARÇO DE 2021: https://www.in.gov.br/web/dou/-/resolucao-n-1-de-26-de-marco-de-2021-310886981

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Lins, L. M., Salerno, M. S., Araújo, B. C., Gomes, L. A., Nascimento, P. A., & Toledo, D. (2014). Escassez de engenheiros no Brasil? Uma proposta de sistematização do debate. *Novos estudos CEBRAP*, 43-67.

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Ministério da Educação. (2 de Julho de 2007). Fonte: Resolução Nº 3, DE 2 DE JULHO DE 2007: http://portal.mec.gov.br/conaes-comissao-nacional-de-avaliacao-da-educacao-superior/323-secretarias-112877938/orgaos-vinculados-82187207/12710-resolucoes-ces-2007

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