UNIVERSIDADE FEDERAL
DE SANTA CATARINA
Pró-Reitoria de Graduação
Departamento de Administração Escolar

CURRICULUM

Course: **603 - AUTOMOTIVE ENGINEERING [Joinville Campus]**
Curriculum: **20251**

Degree: Automotive Engineering

Documentation: Renewal of Recognition – Ordinance No. 921 of 12/27/2018, published in the Official Gazette on 12/28/2018. Resolution No. 09/CGRAD/2012 of 07/18/2012. Course recognized by Ordinance No. 1027 of 12/17/2015, published in the Official Gazette on 12/18/2015.

Objective: The course focuses on the integrated development of vehicles and automotive systems, emphasizing the fundamentals that underlie the solution principles applied in these systems. Throughout the program, automotive product development is addressed as a set of knowledge related to informational, conceptual, preliminary, and detailed product design, also emphasizing aspects related to manufacturing, use, maintenance, removal, and disposal of the automotive product.

Degree Awarded: Automotive Engineer

Degree in: Automotive Engineering

Course Completion Period:	Minimum: 10 semesters	Maximum: 18 semesters
Mandatory Workload:	UFSC: 4410 hours/class	CNE: 3600 hours
		Professional Electives: 144 hours/class
Number of Weekly Classes:	Minimum: 14	Maximum: 25

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1st Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Notions of functions of a real variable. Limit and continuity. Derivative. Applications of derivatives. Definite and indefinite integrals – Substitution method and Integration by parts.							
EMB5001	**Differential and Integral Calculus I**	Req.	72	4				
	Matrices. Determinants. Linear systems. Vector algebra. Study of the line and the plane. Plane curves. Surfaces.							
EMB5005	**Analytic Geometry**	Req.	72	4				
	International System of Units. Atoms and molecules. Chemical bonds and molecular structure. Chemical equations. Stoichiometry. Aqueous solutions. Thermochemistry. Electrochemistry: oxidation-reduction, electrochemical cells, Nernst equation, electrolysis. Iron and steelmaking: production of pig iron and steel. Special steels. Polymers: chemical structure, properties, applications. Ceramics: traditional and advanced ceramics, properties, applications. Composites. Metal corrosion: types and forms, corrosive media, protection mechanisms, monitoring. Fuels and combustion. Environmental Chemistry. Laboratory activities.							
EMB5036	**Chemistry for Engineering**	Req.	72	4	EMB5006			
	Fundamental notions for the preparation and interpretation of sketches and technical drawings. Fundamentals of Geometric Drawing. Projective Drawing. Drawing standards (ABNT). Dimensioning. Scales. Drawing objects in 1st and 3rd angle projection. Isometric perspective. Application of projections in engineering drawings by manual and computational means.							
EMB5055	**Graphic Representation**	Req.	54	3	EMB5035			
	Definitions of science, technology and technique. Technological and social development. Relationships between science, technology and society. Challenges for the contemporary engineer profile. Engineer's roles in the technological and social context. Ethics, morals, values and professional ethics. The Code of Ethics as a tool to strengthen organizational culture. Conscious discipline. Ethnic-racial equality in engineering. Afro-Brazilian and African history and culture. Human rights.							
EMB5063	**Science, Technology and Society**	Req.	36	2	EMB5038			
	Contextualization to academic life (the university, student organizations, support services, physical spaces and laboratory infrastructure). The automotive engineering course, its purpose, graduate profile, and labor market. Contextualization to professional life. Responsibilities of the engineer in the technological and social context. Prevention and combat of fire and disasters in establishments, buildings and public gathering areas. Introduction to product design concepts: methodologies and tools. Introduction to the study of different vehicle systems (suspension, steering, brake, transmission). Introduction to the study of materials and manufacturing processes used in automotive construction. Fundamental concepts of Metrology, measurement errors and proper selection of measurement systems. Introduction to the study of internal combustion engines. Fundamentals of embedded systems and the design of vehicles with electric traction. Aspects of ergonomics and vehicle safety.							
EMB5379	**Introduction to Automotive Engineering**	Req.	36	2	EMB5351			

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2nd Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Vector spaces. Linear transformations. Change of basis. Inner product. Orthogonal transformations. Eigenvalues and eigenvectors of an operator. Diagonalization.							
EMB5007	**Linear Algebra**	Req.	72	4		EMB5005		
	CAD systems, methodology for three-dimensional product modeling. Practice with CAD software. Solid modeling techniques. Product modeling, generation of engineering drawings, technical drawing standards, assembly drawings, assembly, bill of materials.							
EMB5012	**Drawing and Geometric Modeling**	Req.	54	3		EMB5055		
	Integration methods. Applications of the definite integral. Improper integrals. Functions of several variables. Partial derivatives. Applications of partial derivatives. Multiple integration.							
EMB5029	**Differential and Integral Calculus II**	Req.	72	4		EMB5001		
	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.							
EMB5048	**Physics I**	Req.	72	4	EMB5034			
	Reading and interpretation of technical and scientific texts in the field of Engineering. Theoretical and practical study of technical and scientific texts relevant to the execution of academic activities, such as: note-taking, summaries, reviews, articles, seminars. ABNT standards relevant to academic writing. Technical and scientific language. Current grammatical standards. Practice in the appropriation of texts in the field of Engineering.							
EMB5062	**Communication and Expression**	Req.	36	2	EMB5037			
	Context and importance of vehicle product design and development. Aspects of automotive product development: methodologies and tools for the conception and specification of product design. Feasibility of the production process. Fundamentals of scientific methods in solving engineering problems. Principles and stages for planning, conducting, and analyzing experiments. Introduction to modeling, analysis, and simulation methods for engineering design purposes. Laboratory practice.							
EMB5332	**Introduction to Automotive Engineering Design**	Req.	36	2		EMB5379		
	Introduction to computer architecture. Programming logic: problem formalization using 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.							
EMB5648	**Programming I**	Req.	72	4	EMB5600			

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3rd Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Study of the equilibrium of particles and rigid bodies in the plane and in space. Determination of reactions in standard supports used in Engineering. Calculation of centroids of areas and volumes of simple and composite figures. Analysis of distributed forces 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, Structures, and Machines. Determination of axial forces, shear forces, and bending moments in structures and beams. Construction of shear force and bending moment diagrams.							
EMB5011	**Statics**	Req.	72	4		EMB5048		
	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.							
EMB5016	**Numerical Calculus**	Req.	72	4		(EMB5001 and EMB5005 and EMB5648)		
	Introduction to Materials Science and Engineering – materials applied in engineering. Types, classification, and applications of various materials. Atomic structure and interatomic bonds. Crystalline and non-crystalline materials. Imperfections in solids. Diffusion. Metallographic processes. Phase diagrams. Mechanical and dynamic behavior of materials. Failures, fracture, fatigue, and creep. Structure and properties of metallic, ceramic, and polymeric materials. Introduction to composites.							
EMB5022	**Materials Science**	Req.	72	4		(EMB5001 and EMB5036)		
	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.							
EMB5030	**Vector Calculus**	Req.	72	4		(EMB5005 and EMB5029)		
	Gravitation. Fluid statics and dynamics. Oscillations. Mechanical and acoustic waves. Temperature. Heat. Kinetic theory of gases. Laws of thermodynamics. Heat engines. Refrigerators. Entropy. Laboratory activities.							
EMB5039	**Physics II**	Req.	72	4		(EMB5001 and EMB5048)		
	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.							
EMB5057	**Statistics I**	Req.	72	4	EMB5010	EMB5001		

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4th Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Introduction and basic concepts. Work and heat. Properties of pure substances. First law of thermodynamics. First law of thermodynamics applied to control volumes. Second law of thermodynamics. Entropy and the second law of thermodynamics.							
EMB5009	**Thermodynamics**	Req.	72	4		(EMB5029 and EMB5039)		
	Sequences and infinite series. Power series. Taylor series. Fourier series. First-order differential equations. Linear differential equations of order n. Introduction to Laplace transform. Introduction to partial differential equations. Series solutions for linear differential equations. Introduction to numerical methods for solving differential equations.							
EMB5014	**Series and Differential Equations**	Req.	72	4		(EMB5007 and EMB5016 and EMB5029)		
	Stress Analysis – Concepts and Definitions, average normal stress; average shear stress; pure and double shear, allowable stress. Strain Analysis – Concepts and Definitions; specific strain; shear strain. Stress–Strain Relationship – Constitutive equations; Hooke's law; Poisson's ratio; axial load – thermal deformation; statically indeterminate members, compatibility equations, stress concentration. Torsion – Torsional deformation; torsion formula; torsional deflection; stress concentration. Bending – Shear force and bending moment diagrams; bending deformation, simple plane bending, oblique bending, asymmetric sections.							
EMB5021	**Mechanics of Solids I**	Req.	72	4		EMB5011		
	Kinematics of rigid bodies. Dynamics of rigid bodies. Principle of work and energy, momentum, linear and angular impulse for rigid bodies.							
EMB5041	**Dynamics**	Req.	54	3		EMB5011		
	Coulomb's law. The electric field and electrostatic potential. Capacitance and capacitors. Electric current. Magnetic field. Ampere's law. The law of induction. Circuits. Maxwell's equations. Laboratory activities.							
EMB5043	**Physics III**	Req.	72	4		(EMB5030 and EMB5039)		
	Introduction: context and importance of product design. Models of the process and planning of product/service design. Methods and tools for specifying design problems and conceiving products/services. Preliminary design: modeling, analysis, and simulation of design solutions. Detailed design. Prototyping techniques. Development of projects with the Community. Universal Design techniques and concepts in engineering projects.							
EMB5059	**Design Methodology (EXT 18h-a)**	Req.	72	4				800 hs

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5th Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	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 and drag and lift forces on immersed bodies.							
EMB5017	**Fluid Mechanics**	Req.	72	4		(EMB5009 and EMB5030)		
	Fundamental concepts of scientific and industrial metrology; International System of Units; Direct and indirect measurements; Measurement errors; Characteristics of measurement systems; Calibration and metrological traceability; Estimation of measurement uncertainty; Metrological verification; Laboratory practices (mechanical and electrical quantities).							
EMB5061	**Metrology**	Req.	54	3	EMB5033	EMB5057		
	Concepts and notations applied to mechanisms. Fundamentals of mechanism kinematics. Elementary concepts and dimensional synthesis of articulated mechanisms. Cam design. Kinematic analysis of spur gears. Compound gear transmissions.							
EMB5101	**Mechanisms**	Req.	36	2	EMB5105	EMB5041		
	Classification and brief description of various manufacturing processes. Fundamentals of continuous casting and mold casting processes: main parameters, tools, machines and equipment, fields of application. Fundamentals of metal forming processes (rolling, forging, drawing, extrusion, and stamping): main parameters, tools, machines and equipment, fields of application. Fundamentals of powder metallurgy: sintering. Fundamentals of machining processes: turning, drilling, milling, grinding, electrical discharge machining. Main machining parameters. Cutting tools: materials, coatings, and geometries, wear. Surface quality after specific manufacturing processes, dimensional errors. Machines and equipment. Introduction to Computer Numerical Control (CNC). Introduction to CNC machining programming and simulation and integration of CAD/CAM/CNC systems.							
EMB5102	**Manufacturing Processes**	Req.	72	4		EMB5022		
	Shear in long beams – shear stresses in beams; shear in composite structures. Combined loads – stress fields in thin-walled cylindrical and spherical shells. Pressure vessels. Stress transformation – plane stress, principal stresses, Mohr's circle. Transverse deflection in beams – 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.							
EMB5104	**Mechanics of Solids II**	Req.	72	4		EMB5021		
	Basic concepts and fundamental laws. Direct current circuits. Alternating current circuits. Power analysis in alternating current circuits. Three-phase circuits.							
EMB5108	**Electric Circuits**	Req.	72	4		(EMB5005 and EMB5029)		
	History of general administration theory. Basic approaches and evolution of administrative thought. Concept of Administration and administrative functions. Production and Operations Management. Production and Operations Strategy. Basics of Production Planning and Control. Just in Time and Lean Operations. Quality Management. People Management. Basics of Entrepreneurship.							
EMB5120	**Management and Organization**	Req.	72	4				1400 hs

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6th Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Environmental Pollution. Pollution Control of Soil, Water, and Air. Environmental Impacts. Environmental Management. Cleaner Production. Technological Risks and Impacts.							
EMB5064	**Environmental Impact Assessment**	Req.	36	2	EMB5032			
	Introduction to vibration problems in engineering. Terminology. Basic Principles. Single degree of freedom systems: free vibration, energy methods, damping, and forced vibration. Two degrees of freedom systems: free and forced vibration. Multi-degree of freedom systems. Introduction to continuous systems. Introduction to vibration measurement systems.							
EMB5115	**Vibrations**	Req.	72	4		(EMB5014 a n d EMB5041)		
	Basic mechanisms of heat transfer. Basic principles of heat conduction. One-dimensional steady-state conduction. Two-dimensional steady-state conduction. Transient conduction. Applied numerical methods. Basic principles of thermal radiation. Radiation between surfaces. Introduction to convection.							
EMB5123	**Heat Transfer**	Req.	72	4	EMB5103	(EMB5014 a n d EMB5017)		
	Introduction to vehicle dynamics; Mechanical characteristics of tires; Longitudinal dynamics; Vertical dynamics; Lateral dynamics; Rollover; Case studies; Automotive kinematics.							
EMB5316	**Vehicle Dynamics**	Req.	72	4		EMB5041		
	Design for Failure: types of mechanical failures, types of fracture; Failure Criteria for Brittle Materials; Linear Elastic Fracture Mechanics: stress intensity factor, fracture toughness; Elastic-Plastic Fracture Mechanics: plastic zone, determination of fracture toughness; Fatigue failure: types of cyclic loading, finite-life design, infinite-life design, fatigue crack growth, damage tolerance design.							
EMB5352	**Fracture Mechanics**	Req.	36	2		EMB5104		
	Computer Integrated Manufacturing (CIM – Computer Aided Manufacturing). Application of CAD/CAM systems for CNC program generation and machining process simulation. Machining operations and cutting strategies. Methods for toolpath calculation in CAM systems. CNC program post-processing. Machining processes of complex geometric forms in the automotive industry. Transfer and execution of CNC programs on CNC machines. Use of CNC machines and generation of CNC programs both manually and via CAD/CAM systems. Geometric deviations and surface quality of machined parts on CNC machines.							
EMB5353	**Computer-Aided Manufacturing**	Req.	36	2		EMB5102		
	Introduction and fundamental definitions; thermochemistry; chemical kinetics; thermal-chemical coupling of reactive systems; premixed laminar flames; laminar diffusion flames; liquid combustion; introduction to turbulent combustion.							
EMB5431	**Fundamentals of Combustion**	Req.	54	3		(EMB5014 a n d EMB5017)		
	Fundamentals of economics. Basic principles of Engineering Economics. Financial mathematics. Investment and financing modalities. Bases for comparing investment alternatives. Taxes and depreciation. Cost-volume-profit (CVP) analysis. Sensitivity analysis. Equipment replacement analysis. Alternative analysis under risk and uncertainty. Topics in Finance and Investments. Use of simulation in Engineering Economics in case studies.							
EMB5961	**Engineering Economics**	Req.	54	3		EMB5057		1400 hs

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7th Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	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, vibrations, temperature. Ergonomic work analysis. Occupational safety.							
EMB5056	**Ergonomics and Safety**	Req.	36	2	EMB5026			
	CAE (Computer Aided Engineering) systems. Stiffness matrix and assembly of the system of equations. One-dimensional and two-dimensional linear problems. Degrees of freedom and interpolation functions of elements. Material constitutive model. Stress analysis and convergence curve. Isoparametric elements. Numerical integration. Application in commercial software.							
EMB5117	**Introduction to the Finite Element Method**	Req.	72	4		EMB5104		
	Study of bolted joints. Helical springs. Shafts. Hub–shaft connections. Rolling and sliding bearings. Spur gears. Gear reducers. Couplings. Flexible mechanical elements.							
EMB5119	**Machine Elements**	Req.	72	4	EMB5110	(EMB5101 and EMB5104)		
	Fundamental concepts, definition, classification, and typical applications of Internal Combustion Engines (ICE). Ideal and real thermodynamic cycles (theoretical and indicated). Parameters and characteristic curves of ICE (engine performance). Fuel metering and distribution systems. Gas exchange in the cylinder – 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.							
EMB5304	**Internal Combustion Engines I**	Req.	72	4		(EMB5123 and EMB5431)		
	Concept of innovation. Types of innovation. Innovation strategies. Innovation as an organizational process. Mechanisms for fostering and cooperation in research and development. Entrepreneurship. Characteristics, types, and skills of the entrepreneur. Business plan: stages, processes, and preparation.							
EMB5320	**Entrepreneurship and Innovation**	Req.	36	2		(EMB5059 and EMB5120 and EMB5961)		
	Introduction to hydraulic and pneumatic systems: components, modeling, and control. Hydraulic and pneumatic brake systems. Disc and drum brakes. ABS brakes. Brake system design.							
EMB5327	**Hydraulic, Pneumatic and Brake Drives**	Req.	54	3	(EMB5047 eh EMB5313)	EMB5316		
	Classification of steels used in automotive 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 Tailored Blank processes and hydroforming of sheets and tubes. Forging and heat treatment of automotive steel components. Criteria for selecting manufacturing processes of automotive components. Manufacturing planning: process sheets and operation sheets.							
EMB5341	**Vehicle Construction Materials and Processes I**	Req.	36	2	EMB5355	EMB5102		
	Guidelines for extension activities. Fundamentals of heat treatment theory: phase transformations, relationship of microstructure with mechanical properties of treated products. Main heat treatment processes and methods for parameter control. Equipment and devices used in heat treatment practice. Surface finishing processes in treated parts. Problem-solving methods associated with heat treatment technologies. Experimental planning applied to heat treatment. Technical standards for heat treatment practice. Destructive and non-destructive tests used in process qualification and product quality. Stress analysis from heat treatment. Cost analysis associated with the process. Practice in an industrial laboratory.							
EMB5392	**Heat Treatment Technology Applied to Automotive Components (EXT 72h-a)**	Req.	72	4		EMB5102		

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8th Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Research and the scientific method. Formulation of the research problem. Construction of hypotheses. Types and characteristics of research. Preparation of research projects. Preparation of reports. At this stage, the project for the undergraduate thesis will be proposed, including the following content: Title, theme, problem statement, hypotheses, objectives, justification, methodology, expected results, schedule, and list of main references.							
EMB5044	**Undergraduate Thesis Planning**	Req.	36	2				2592 hs Ob
	Process of conceiving products, services, and businesses. Application of management concepts and tools. Application of models for the development of new businesses.							
EMB5100	**Entrepreneurship and Innovation Project**	Req.	72	4		EMB5320		
	Main components of chassis and bodywork. Types of chassis. Chassis design. Types of steering systems. Steering system design. Types of suspension systems. Suspension system design.							
EMB5303	**Vehicle Systems I: Chassis, Suspension, Steering**	Req.	72	4		(EMB5119 and EMB5316)		
	Main types, components, and classification of molds and dies for the automotive industry. Basic principles of mold and die design aimed at improving vehicle components. Maintenance, materials, heat and surface treatments used in tooling.							
EMB5324	**Mold and Die Design for the Automotive Industry**	Req.	36	2		(EMB5012 and EMB5102)		
	Introduction to the vehicle powertrain. Types of transmission systems: manual and automatic. Actuation and control systems, components, and operation. Transmission system design.							
EMB5329	**Transmissions**	Req.	54	3	(EMB5047 eh EMB5313)	EMB5119		
	Classification of joining processes. Fundamentals of joining processes: terminology, types of joints and bevels, welding positions. Joining by forming: bending, clinching, and 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 oxy-fuel cutting. Resistance welding: spot, projection, seam, and flash. Laser welding. Friction welding. Brazing. Applications in automotive engineering.							
EMB5342	**Welding Processes for Automotive Engineering**	Req.	72	4	EMB5324	(EMB5022 and EMB5108)		
	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 central tendency and variation, graphical evaluation. Sampling plans in attribute inspection. Design of experiments: general guidelines, factorial design, statistical analysis, residual analysis.							
EMB5350	**Statistical Quality Control**	Req.	72	4	EMB5385	EMB5057		
	Physicochemical properties of polymers. Rheological properties of molten polymers. Processing of thermoplastic materials: extrusion, injection, blow molding, thermoforming, and rotational molding. Processing of thermosetting materials: manual, spray-up, resin transfer molding, SMC, BMC.							
EMB5356	**Materials and Manufacturing Processes for Vehicle Construction II**	Req.	36	2		EMB5022		

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9th Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Consolidation of knowledge acquired during the course, aiming to develop the student's ability in the conception, implementation, and/or evaluation of solutions in situations related to the field of the respective program.							
EMB5045	**Undergraduate Thesis**	Req.	72	4		EMB5044		
	Basic principles of aerodynamics. History of aerodynamics 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.							
EMB5317	**Vehicle Aerodynamics**	Req.	72	4		(EMB5123 and EMB5316)		
	Product design applied to vehicle development. Preliminary design, detailed design, testing, and validation of vehicle product design.							
EMB5326	**Vehicle Product Development**	Req.	54	3		(EMB5303 and EMB5327 and EMB5329)		
	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.							
EMB5360	**Introduction to Electric Vehicles**	Req.	72	4		EMB5108		
	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 valve, capillary tubes, short tubes. Variable expansion devices: float-type expansion valves, pressure-actuated expansion valves, thermostatic expansion valves, electric valves. Reciprocating compressors, compression process, volumetric efficiency, capacity control methods. Psychrometry and psychrometric processes. Air conditioning and vehicle refrigeration.							
EMB5386	**Refrigeration and Air Conditioning**	Req.	54	3		(EMB5009 and EMB5017)		
	Guidelines for extension activities. Diagnostic analysis in the community interested in vehicles. Development of digital content in the area of vehicle systems. Organization of thematic seminars for institutional dissemination about vehicle systems and associated systems.							
EMB5391	**Transforming Society with Vehicles (EXT 72h-a)**	Req.	72	4		(EMB5303 and EMB5327 and EMB5329)		

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10th Semester

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
	Internship experience in industries, research institutions, or companies that make use of the technical content of the program; practical training through the application of technical knowledge acquired during the course; development or improvement of professional and interpersonal relationships.							
EMB5399	**Mandatory Internship**	Req.	216	12				3496 hs Ob

Extension Activities

The student must complete 450 class-hours in extension activities, of which 234 class-hours will be in mandatory courses and 216 class-hours in extension activities.

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
EMB5390	**Extension Activities**	Req.	216	12				

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Atividades Complementares

Course		Type	Hours	Credit	Equivalents	Prerequisite	Group	Prereq Hours
They are part of the curriculum and aim to enrich the teaching-learning process, prioritizing the enhancement of social and professional education.								
EMB5393	**Complementary Activities**	Req.	108	6				2400 hs

Notes
ORDINANCE 022/2023/PROGRAD

Extension Activities – The student must complete 450 class-hours in extension activities, of which 234 class-hours will be in mandatory courses and 216 class-hours in extension activities. The workload of extension activities may consist of up to 180 class-hours in projects, up to 180 class-hours in courses, and up to 180 class-hours in events.

Electives – The student must complete 90 class-hours in elective courses suggested by the program curriculum or in any courses offered at UFSC, whether Undergraduate or Graduate (EMB5387 and EMB5388) – amended by Ordinance No. 52/2025/PROGRAD.

Complementary Activities – The student must complete 108 class-hours of complementary activities, which may include technical lectures, extension courses, technical visits, scientific initiation projects, non-mandatory internships, among others.

Legend: Type: Req. = Mandatory Course; Op = Elective Course; Es = Internship; Ex = Extracurricular
Hours (hs) = Class-hour
Equivalent = Equivalent Course
Group = Courses that must be taken together