

# FEDERAL UNIVERSITY OF ABC

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DEAN OF GRADUATE STUDIES CHARLES MORPHY DIAS DOS SANTOS

## INSTITUTIONAL PROJECT

### Institution

Federal University of ABC (Universidade Federal do ABC)

### Goals of the Institutional Project

The objectives of the Institutional Internationalization Project of the Federal University of ABC (UFABC) are twofold. The first is to create stronger bonds and to expand the collaborations between our Graduate Programs and foreign universities and research institutes with which there are already solid working partnerships. The second is to promote international collaborations in areas where a clear internationalization potential was identified. The curriculum and research framework of UFABC is based on interdisciplinary axes, reflected in both undergraduate and graduate courses. Interdisciplinary studies allow the proposition of integrative solutions to complex problems that relate from micro to macrocosm. It considers both generalities, covering different areas of research, and specificities of a given discipline in a constant search to deal with contemporary scientific, political, social and economic challenges. Interdisciplinarity is a movement or a disposition for the new, generated in the tension between fields of study, to produce a satisfactory complex response. The Institutional Internationalization Project of UFABC submitted to CAPES-PrInt was organized in this perspective. Geographical barriers make little sense to the construction of interdisciplinary knowledge. Thus, discussions about the internationalization of academic research are necessary in a networked world in which distances diminish at every instant. The insular construction of knowledge has increasingly been substituted for collaborative initiatives including multiple countries. In fact, internationalization is one of the defining forces of excellence in higher education and is a process for maximizing research quality and impact, as well as providing broad and plural training for the academic community at different levels. Taking into account the *raison d'être* of UFABC - the construction of interdisciplinary knowledge in frontier areas -, the internationalization project is based on five themes, covering different Graduate Programs. The project unites professors and Ph.D. students distributed in a broad spectrum of interests, experiences and academic know-how. The themes are: (1) Biosystems and Biotechnology Tools; (2) Advances in Nanosciences, Structure of Matter, Quantum Physics and Advanced Materials; (3) Challenges of sustainability for the 21st century: energy, technology, development and fight against inequality; and (4) Information and Communication Technologies, Complex Systems and Smart Applications. The following Graduate Programs are leading proposals in this Internationalization Project: Science and Technology / Chemistry; Physics; Nanosciences and Advanced Materials; Biosystems; Biotechnology; Computer Science; Human and Social Sciences; Information Engineering; Education, History of Science and Mathematics; Evolution and Diversity; Mathematics; Neuroscience and Cognition; and Territorial Management and Planning. Since its creation in 2006, UFABC has invested efforts in research and graduate studies based on the spirit of knowledge construction beyond Brazilian borders. Numerous research groups have gained international projection, reflected in high-impact academic-scientific production and the establishment of UFABC as a priority target for foreign partners. In strategic areas such as chemistry, physics, nanosciences, complex systems and smart applications, urban planning, biodiversity and biotechnology, UFABC has been able to establish permanent partnerships inside and outside Brazil. In this way, the Institutional Internationalization Project of UFABC has the expansion of these collaborations as its central goal, which will allow an increase in the impact of our scientific production and the formation of highly

qualified human resources at the Graduate level. This goal is in line with the perspective of strengthening and increasing the relevance of Brazilian science concerning the main challenges of the 21st century - climate changes, sustainable processes and new materials, loss of biological diversity, need for education and scientific literacy, and related themes. In its 12 years of existence, UFABC has participated in many different activities related to its internationalization goals, both in undergraduate and graduate studies, as described in its Pedagogical Project and Institutional Development Plan. The position of UFABC in rankings illustrates some of the milestones achieved. In recent years, UFABC has consistently appeared in the top positions of internationalization rankings concerning academic and scientific production. In the Latin American ranking of Times Higher Education, for example, UFABC is ranked 14th among 71 universities evaluated - if only Brazilian institutions are considered, our position rises to eighth. It shows the commitment and responsibility of UFABC in training highly qualified masters and doctors, reflected in the growing number of papers in journals of high international impact, and collaborations with important Brazilian and foreign research institutes. Our goals are similar to CAPES': to seek excellence in knowledge construction and to increase the visibility of Brazilian science. Although we have had some success in internationalization, the initiatives have been atomic or sectorial, focused on individual actions or nucleated in Graduate Programs and research groups. UFABC considers Capes-PrInt as an opportunity to achieve an even broader goal: the construction of interdisciplinary knowledge of global excellence aligned with the training of highly qualified faculty and students. At the undergraduate level, UFABC has been able to fulfil its role in vanguard interdisciplinary training. At the graduate level, we understand that qualifying students and the faculty is tightly connected to an institutional vision focused on internationalization. Thus, the themes and actions described in our Institutional Project Capes-PrInt converge with the Institutional Plan of Internationalization of UFABC for 2018-2023. Nonetheless, the Institutional Internationalization Project will also allow UFABC to expand its network of international contacts and partnerships, bringing additional support to the areas in which the internationalization process has been happening consistently since the first graduate programs at the university. The Project has allowed us to strategically rethink the Graduate Studies at UFABC in light of the internationalization process. We expect to develop innovative initiatives, exchanges, and opportunities for partnerships concerning Science, Technology, and Innovation. The corollary of the Institutional Internationalization Project of UFABC, in dialogue with our goals as stated in the Institutional Plan for Internationalization for the next five years (2018-2023) and the Institutional Development Plan, is the establishment of a culture of internationalization at UFABC. Such culture will make the faculty, students and technical-administrative staff converge towards the goal of making UFABC a global leader in the construction and dissemination of cutting-edge knowledge in the priority research themes.

**DIAGNOSTICS****Strengths****Title**

The existence of the International Affairs Office

**Justification**

The International Affairs Office was created in 2010 aiming the development of the international policies of Federal University of ABC (Universidade Federal do ABC, acronym UFABC). It is oriented to establish international cooperation policies with foreign institutions through students' exchange programs and research agreements in multilateral sets. Among its attributions, there are negotiating and establishing inter-institutional cooperation agreements, supporting projects of academic exchange, managing institutional international mobility programs, coordinating students, language courses for UFABC staff and external community, and hosting international delegations. The International Affairs Office has also developed the English version of the institution website (working with other areas at UFABC), and has coordinated the process of translating to English the undergraduate courses' content and syllabus, as well as the required bibliography. Considering the need to improve internationalization to offer an environment of teaching, research and outreach proper of the contemporary world, as well as the Institutional Development Plan (PDI), which highlights the importance of internationalizing the university community, the University Council has established in June 2017 the permanent International Affairs Committee (IAC) as a consulting and deliberative body of the International Affairs Office to contribute to the goals of internationalization of UFABC. IAC works in tune with other Commissions and Committees with related attributions which were created by the UFABC General Regulations and the University Council.

**Title**

The Institutional Plan of Internationalization (2018-2023)

**Justification**

The history of internationalization at UFABC and this Plan merge with the University's history itself. It can be summarized in seven different moments: (1) 2006: UFABC's Pedagogical Project: encouragement to international student mobility; (2) 2010: Establishment of the International Affairs Office; (3) 2013: Publication of the Institutional Development Plan 2013-2022; (4) 2014: The setup of the Work Group "Strategic Vision and Guidelines to Internationalization"; (5) 2015: The Strategic Vision and Guidelines for Internationalization were established; (6) 2017: Publication of the Pedagogical Institutional Project; (7) 2018: At the beginning of 2018, an assessment of the internationalization strategies proposed by the work group was done so, in possession of the results, the objectives and strategies could be reached. The Institutional Plan of

Internationalization (2018-2023) results from this joint effort. The Plan establishes the focus and priorities of the university's actions concerning the internationalization for the next five years, from 2018 to 2023. By 2023, the main goal is that internationalization, once widely inserted into the university routine, disseminated and experienced by the academic community, may allow UFABC to become an international reference in research, teaching, and outreach. The Plan aims to: 1. Transform UFABC into an international reference; 2. Increase the number of teaching, research and outreach projects with international collaboration; 3. Amplify the relevance of the international scientific production; 4. Internationally qualified faculty and staff; 5. Increment international mobility programs; 6. Attract foreign students, faculty, and researchers; 7. Encourage the establishment of double-degree agreements; 8. Internationalize the curriculum; 9. Train the academic community in foreign languages, especially English, and foreigners in Portuguese. After the unanimous approval in the International Affairs Committee, the Institutional Plan of Internationalization was submitted on March 27th, 2018 to appraisal and approval of the University Council. On April 9h, 2018, in its decision act number 162, the Plan was published to the whole community.

**Title**

Interdisciplinarity as the basis for research, teaching, outreach, and management

**Justification**

UFABC has research efforts and curricular structure based on interdisciplinary pillars: Communication and Information, Structure of Matter, Energy, Transformation Processes, Representation and Simulation, and Humanities and Applied Social Sciences. At the undergraduate level, the interdisciplinarity begins when students enter UFABC by choosing one of the two Interdisciplinary Bachelor Programs (Bachelor in Science and Technology or Bachelor in Sciences and Humanities). During their interdisciplinary bachelor programs, the student has the option to enrol at specific programs (such as Engineering Programs, Bachelor Programs or Teaching Degrees in Biology, Physics, Chemistry, Philosophy, and Mathematics, and B.A. in Computer Science). The need to overcome disciplinary barriers is also a foundation of UFABC's administrative and management policies. There are no departments as in traditional universities but centers – Center for Natural and Human Sciences (CCNH), Center for Mathematics, Computation and Cognition (CMCC), and Center for Engineering, Modeling, and Applied Social Sciences (CECS). Since interdisciplinarity is based on integrative approaches to solving complex problems, the knowledge construction at UFABC consider both general topics from different areas and specificities restricted to a certain field of study. Hence, teaching and research initiatives at UFABC take advantage of the tension between two or more research areas in their constant challenge to deal with contemporary scientific, political, social, and economic issues. These fundamentally interdisciplinary problems do not recognize geographic barriers. Discussions on internationalization of academic research are essential in a world where distances have been reduced each day. The isolated knowledge construction is being replaced by collaborative initiatives among several countries. Hence, internationalization is, in fact, one of the defining forces of excellence in higher education.

In addition to maximizing the quality and impact of research, internationalization processes allow a comprehensive and plural education for members of the academic community in different levels.

**Title**

Infrastructure, logistics and accessibility to host foreign students and researchers

**Justification**

Both UFABC campuses, in Santo André and São Bernardo do Campo, are located in the Metropolitan Area of São Paulo. According to Fundação Sistema Estadual de Análise de Dados (Fundação SEADE), the highest concentration of infrastructure of the State of São Paulo (including roads) is located in the Metropolitan Area of São Paulo and its surroundings. The region has five large-size airports – Guarulhos, Congonhas, Campo de Marte, Viracopos and São José dos Campos. Guarulhos and Congonhas airports are the two most significant in the country in passengers' traffic, with flights to all Brazilian States. Many direct international flights leave from Guarulhos, connecting São Paulo to Latin America, North America, Europe, and Asia. According to SEADE, the Metropolitan Area of São Paulo has the greatest landline phone technology network of the State. Both Santo André and São Bernardo do Campo campuses are connected to the city of São Paulo by public transport: Turquoise Line 10 train provided by Companhia Paulista de Trens Metropolitanos (CPTM) connects São Paulo to Rio Grande da Serra, going thru Santo André, and the Bus Lane ABD connects São Bernardo, Diadema, Santo André, Mauá, and São Paulo. UFABC has free transport for faculty, students, staff, and private contracted personnel by chartered bus lines between the campuses of Santo André and São Bernardo do Campo, and between the train and bus station and the campuses. The six chartered bus lines work all day long, from 6:30 to 23:30 and UFABC President's Office assures annual budget for its maintenance and operation. Sustainable Logistic Management Plan has been the basis for training the university community to perform sustainable biddings, diagnosis of the campuses accessibility, installation of safer bike racks, and urban mobility proposals for the city hall of Santo André and São Bernardo do Campo. To increase the number of trained employees, UFABC has implemented a training abroad policy. There was also an increase in the number of language courses offered: since 2015, Spanish, Italian, French, and Portuguese for Foreigners courses have been created, and 2742 students benefited.

**Title**

Internationalization as a central issue in the Institutional Development Plan

**Justification**

UFABC has emphasized the importance of becoming an international institution since its foundation in 2006. The Pedagogical Project encouraged international student mobility. Further, the Institutional Development Plan established UFABC's mission from 2013 to 2022: to promote the advancement of knowledge through

teaching, research and outreach actions, having as basic foundations the interdisciplinarity, excellence and social inclusion. To achieve such goal, the PDI considers the internationalization process to be fundamental in a broad sense, from preparing faculty, students, and employees to constructing internal conditions for properly hosting foreign students and researchers who come to UFABC, assuring information and experiences exchanges. PDI stimulates the engagement of faculty and staff in mobility program for graduate, research, and outreach, considering it to be of great importance to UFABC's intent to increase internationalization. In this regard, it is essential to create a university environment of 'international standard' in teaching, research, and outreach. The characteristics of world-class universities (talents, resources, and governance, aside from high demand by its students, and leadership in scientific research and technological transfer) are discussed in the of UFABC, guiding its actions. The several areas of UFABC have been playing an important role in this continuous process.

## **Weaknesses**

### **Title**

Brain drain due to research funding restrictions

### **Justification**

Brain drain is the emigration of highly qualified professionals who are experts in their fields of knowledge from developing countries mainly to North America and Europe, where opportunities for their full potential development are clearer. In October 2017, the Federal Senate Committee for Science, Technology, Innovation, Communication and Informatics discussed the reasons for Brazilian brain drain in a public hearing. The two main reasons identified were the lack of funding for research and the bureaucracy for scientific projects evaluation and approval in Brazil. The drastic budget reduction in science, technology, and innovation after 2016 has somehow contributed to this scattering. The brain drain, though, is also internal: due to budget restriction imposed to Higher Education Institutions (HEI), notably (but not exclusively) the Federal ones, hired professors of new universities, with less possibilities of external funding to achieve its goals of teaching and research, end up being recruited by more traditional universities. As these institutions have a better history of obtaining funding for research, their faculty expects fewer obstacles to scientific investigation and human resources training in Graduate level. Besides, less traditional HEIs are excluded or remain on the borderline of decision making related to Higher Education and research policies made by Brazil governments and funding agencies. This increases the inequalities among Brazilian HEIs and explains somewhat why the high impact scientific production and the technological innovation in Brazil, when they exist, are restricted to few institutions – from the Graduate Programs perspective, for example, most of the funding from federal and state agencies are centralized in few institutions.

### **Title**

Limitations and barriers to alternative funding sources for research and graduate studies

**Justification**

The recent scenario of profound budget restriction that the Higher Education Institutions are going thru was imposed by the Budget Annual Law (from Constitutional Amendment no. 95). In addition to the defense of more public funding for Higher Education Institutions, it is urgent to think about alternative funding sources to assure the university's activities. In this regard, the Scientific and Technological Research Foundations are management tools of teaching, research, and outreach that have been expanding significantly by recent improvements in Brazilian laws. These Foundations allow fundraising to projects that foster teaching and research in undergraduate and graduate education, as well as scientific, technological, and innovation development. In Brazil, some Foundations attached to universities have historically been criticized, due to lack of transparency in managing budgetary and human resources. This produces limited benefits, internal conflicts, and exclusive dependency on external demands (since the Foundation activities do not necessarily converge with the university priorities for research, teaching, outreach, and management). If part of the recent strategy to maintain the university public mission is based on alternative fundraising (in which the foundations are crucial), it is essential the establishment of clear rules for better distributing the resource, ensuring transparency. Besides, tightening the bonds between Higher Education Institutions and Scientific and Technological Research Foundations should be a process conducted by technological and scientific demands, and not only by the potential for generating financial resources.

**Title**

Language barriers – English as second language still not widespread among students

**Justification**

The introduction of at least a second language is fundamental to the internationalization activities of teaching, research, and outreach in university. Nevertheless, the lack of proficiency in a foreign language still hinders international partnerships and collaborations. Many actions described in UFABC's Institutional Plan of Internationalization for the next five years (2018-2023) are meant to overcome language barriers. The problem is a consequence of inadequate education – especially in English – in Secondary schools; most of the time, the difficulties remain throughout undergraduate and even graduate education. Offering English-taught undergraduate courses, having seminars and events in a second language, and the constant offer of foreign language courses are UFABC's initiatives to reduce these language barriers.

**Title**

Limited number of graduate scholarship offered by funding agencies

**Justification**

The Federal University of ABC was founded in 2005 and has 24 Master's and 14 Ph.D. programs, three professional masters and one Academic Industrial Ph.D. In 2017, as a joint effort from the UFABC President's Office, the Office of Graduate Studies and the Graduate Programs Coordination, UFABC got its



best ranking in CAPES evaluation: eight of our Graduate Programs were graded better, and none was diminished. Despite constant positive evaluations of our Graduate Programs and its top position in internationalization rankings of scientific research, UFABC still has a few numbers of graduate scholarships (for example, only 25.5% of our graduate students have CAPES scholarships), which brings challenges for maintaining students in one of most expensive Brazilian regions.

**Title**

Lack of exclusive physical infrastructure to allocate foreign students and researchers in housings and offices for certain periods

**Justification**

In recent years, there has been a dramatic reduction in the available budget for the Federal Higher Education Institutions. This budget reduction resulted in the delay of construction works in progress, hindering the process of reorganizing the internal spaces in the two UFABC campuses (Santo André and São Bernardo do Campo). The possibility of providing physical space and exclusive infrastructure for the allocation of foreign students, faculty, and researchers for more prolonged periods is also hampered. Regarding capital budgeting, UFABC came from a situation of an average of R\$ 79.5 million (2011 -2014) to an average of R\$ 35 million (2015 - 2017). This reduction occurred when the L Block and the Tamanduatehy Block on the Santo André campus, and the Zeta, Omega, Hangar and Lambda Blocks on São Bernardo do Campo campus were still under construction. The new L Block (which includes, among others, the Office of Research, the Innovation Agency, and research laboratories) has been progressively occupied since the beginning of 2017, but our most significant challenge in campus Santo André is the construction of the Tamanduatehy Block. This work is already under negotiation with the Brazilian Ministry of Education to reduce its scope and to enable its completion until 2019. Regarding the campus of São Bernardo do Campo, buildings and facilities such as the Hangar and the Communal Center are under construction, but negotiation with the Ministry of Education for the construction of the Lambda Block is still necessary. As the project of this block was interrupted when it was still in the design phase, and not of construction, its resumption presents an additional challenge.

**Do you have a well-defined institutional vocation?**

Yes

**Describe the vocation of your institution**

To promote the advancement of knowledge through teaching, research and outreach actions based on the foundations of its pedagogical project: interdisciplinarity, excellence, and social inclusion

**Describe other relevant information about the level of internationalization of your institution**

The Office of Graduate Studies and the Office of Research both have active participation in the internationalization of UFABC, fostering institutional collaborations with universities, research centers, and foreign companies, and supporting international partnerships made by the faculty of UFABC and the graduate students. At the Office of Research, initiatives such as the creation of the Office of Research Integrity are in line with international protocols that guide research. The Office of Graduate Studies publicizes and supports initiatives such as CAPES' Sandwich Abroad Program, receives foreign students through the Organization of American States (OAS), and funds the participation of the faculty and students in scientific congresses abroad. These are examples of UFABC's commitment to excellence. Internationalization has also been implemented at home, through strategies such as COIL (Collaborative Online International Learning). Aiming to become a potential target for international partners, UFABC has sent representatives to international education events such as the annual conferences of the Coimbra Group, NAFSA, FAUBAI, and EAIE. In this same sense, an Exposition of UFABC was made in Étudier au Brésil, Studying in Brazil. UFABC also held events such as the German Day Organization, Europe Education Day and the 2nd Brazil-Turkey Seminar on Nanotechnology. In 2015, the International Relations Commission was created as a deliberative and consultative forum for internationalization issues. UFABC participated actively in the Science Without Borders program, with 1341 undergraduate students, as a mechanism to foster internationalization initiatives. Regarding cooperation agreements with foreign universities, UFABC currently has 52 current or in process agreements. The University has been offering qualification courses for its faculty, aimed at writing high impact scientific papers and preparing proposals for international research project calls. British Council courses in "Teaching in English" and "Learning and Teaching" are systematically offered. There has also been funding for courses and mobility through projects such as Erasmus and British Council. The University has encouraged the establishment of agreements for dual degrees in undergraduate and graduate studies, including co-tuition for Ph.D. (currently there are five signed co-tutelage contracts).

**THEMES****Theme 1****BIOSYSTEMS AND BIOTECHNOLOGY TOOLS****Partner countries**

Portugal; Mexico; Switzerland; Argentina; France; Netherlands; India; Japan; Czech republic; Chile; Russia; Ukraine; France; Australia; Japan; Spain; Canada; Czech republic; Ireland; Germany; United Kingdom; Chile; U.S; Italy; Germany.

**Justification**

BIOLOGICAL SYSTEMS OR BIOSYSTEMS ARE COMPLEX GROUPS OF ELEMENTS THAT INCLUDE LIVING ORGANISMS. THEY ARE STRUCTURED IN DIFFERENT LEVELS OF ORGANIZATION: BIOMOLECULES, METABOLIC PATHWAYS, ORGANELLES, CELLS, TISSUES, ORGANS AND COMPLEX ORGANISMS. BIOLOGICAL SYSTEMS ARE THERMODYNAMICALLY OPEN, MAINTAINED IN A DYNAMIC EQUILIBRIUM. THEY UPTAKE, TRANSFORM AND STORE COMPOUNDS (MATTER), ENERGY AND INFORMATION, OVER 3.5 BILLION OF YEARS DURING THE LIFE EVOLUTION ON EARTH. THIS THEME WILL DEAL WITH (1) THE STUDY OF THE MOLECULAR CHARACTERISTICS OF SEVERAL BIOSYSTEMS FORMED BY THEIR BASIC STRUCTURAL COMPONENTS, ACQUIRING HIERARCHICAL LEVELS OF ORGANIZATION. THOSE FEATURES RESULT IN STRUCTURAL RELATIONSHIPS AND INTERACTIONS AT THE SAME OR BETWEEN DIFFERENT LEVELS OF ORGANIZATION, AND (2) MULTIPARAMETRIC ANALYSES USING COMPUTATIONAL AND EXPERIMENTAL MODELS IN ORDER TO SIMULATE MOLECULAR STRUCTURES AND INTERMOLECULAR INTERACTIONS; THE DEVELOPMENT, CHARACTERIZATION AND EVALUATION OF NEW TECHNOLOGIES AND THEIR THERAPEUTIC APPLICABILITY FOR THE TREATMENT AND DIAGNOSIS OF HUMAN AND/OR VETERINARY PATHOLOGIES. THIS TOPIC WILL ALSO PRESENT HIGHLIGHTS IN BIOINFORMATIC, TISSUE ENGINEERING, NANOMEDICINE, BIOPHOTONICS, PLANT AND REPRODUCTION BIOTECHNOLOGY, MEDICAL PHYSICS AND INDUSTRIAL ENZYMES. THE GENERATION OF INNOVATIVE BIOTECHNOLOGICAL PRODUCTS IS DEPENDENT ON BASIC RESEARCH BEING NECESSARY FINANCIAL SUPPORT FOR ALL PROCESSES INVOLVED IN TECHNOLOGICAL INNOVATION. THUS, STUDIES RELATED TO THE IDENTIFICATION AND CHARACTERIZATION OF BIOMOLECULES AND BIOLOGICAL SYSTEMS, BY DIFFERENT METHODOLOGIES, CAN CONTRIBUTE TO THE GENERATION OF NEW STRATEGIES FOR THE DIAGNOSIS AND THERAPEUTIC INTERVENTIONS, PRODUCING SPECIALIZED HUMAN RESOURCES WITH INTERDISCIPLINARY PERFORMANCE TO ATTEND THE CLAIMS OF THE PRODUCTIVE SECTOR AND CONTRIBUTE TO THE GENERATION OF KNOWLEDGE RELATED TO BIOSYSTEMS AND BIOTECHNOLOGY. BESIDES, THE ACADEMIC EDUCATION OF HUMAN RESOURCES WITH CAPABILITIES FOR TEACHING, RESEARCH AND PRODUCE BIOTECHNOLOGICAL PROCESSES OR PRODUCTS IS ALSO JUSTIFIED TO PROMOTE DIFFERENT APPROACHES BETWEEN THE ACADEMIC AND PRODUCTIVE SECTORS OF ACTIVITIES.

**GOALS****Goal 1**

To enable the contact of UFABC students and professors with companies and research groups overseas where the transfer of academic knowledge to industries is nowadays a reality

**Description**

The distribution of biotech-based patents all over the world corresponds to the investment made in fundamental research in previous years. However, despite the recent advances in the history of biotechnology in Brazil and its international recognition, we understand that there is still a minimum investment of the public sector and little interest from the industries. This scenario, however, is progressively changing due to some initiatives, albeit modest, in both sectors. In this regard, some essential mechanisms for protecting intellectual property have created the habit of thinking about patenting products and processes of biotechnological interest. Thus, one of the objectives is to provide the contact of the UFABC staff (professors and students) with countries where this conversion of knowledge into innovation is a reality, as well as the contact with countries where biotechnology companies invest in clinical trials due to the existence of patents which may be explored commercially.

**Goal 2**

Promote scientific advances within the framework of genetic therapies

**Description**

Gene therapy is based on the treatment of severe diseases via the introduction of healthy genes using recombinant DNA techniques. It consists of methods for the treatment of degenerative diseases or diseases without other known ways of treatment. Although recent, we expect that these technologies may reach clinical trials within a couple of years. Therefore, our motivation is focused on the possibility of the UFABC professors and students to be in contact with international research groups embracing such technologies for different purposes (monogenic diseases, cancer, Parkinson's disease, among others). For the point of view of applied sciences, we understand that the knowledge of mutations responsible for some diseases can lead to the development of diagnostic tests and marketable drugs. Thus, we consider of due relevance the scientific collaborations between UFABC and research groups working on these strategies.

**Goal 3**

To internationalize the academic-scientific activities of graduate students

**Description**

The goal is to stimulate Ph.D. students to participate in teaching, research and outreach activities in universities and foreign research institutions, enabling them to come into direct contact with what has been built abroad in science and technology. The internationalization project will allow Brazilian students to have academic experience in institutions abroad - with their idiosyncrasies and differences concerning the Brazilian universities - and to improve its conversation, reading, and writing skills in another language

(mainly English). We also expect the development of collaborations and co-authorship in different academic products (papers, book chapters, patents, etc.).

**Goal 4**

To train professors and researchers in foreign institutions

**Description**

The goal is to stimulate post-doctoral periods abroad for the institution's faculty, allowing them to update themselves with the state-of-the-art of their areas of research, and to establish bilateral collaborations with foreign institutions. Here, the goal is also to carry out short-term missions abroad, to finish papers in progress, to participate in teaching and research seminars, and to present the results obtained in the partnerships developed in the Capes-PrInt Institutional Project.

**Goal 5**

To attract foreign students and researchers to Brazil

**Description**

One of the goals of the Capes-PrInt Institutional Project is to make the Federal University of ABC a potential partner of foreign institutions and a pole of attraction of foreign students and researchers. We expect that our institutional vocation - to promote teaching, research and outreach activities based on interdisciplinary, excellence and social inclusion - along with a four-year internationalization project and budget availability for missions abroad and scholarships may attract foreign students and researchers. In this sense, Capes-Print will increase our chances of establishing international collaborations and creating, in loco, an organization culture tightly connected to the internationalization process that may definitively insert UFABC in the roll of genuinely global institutions.

**Theme 2****ADVANCES IN NANOSCIENCES, STRUCTURE OF MATTER, QUANTUM PHYSICS AND ADVANCED MATERIALS****Partner countries**

Canada; United Kingdom; Chile; U.S; France; Mexico; Portugal; Colombia; Ireland; Japan; Germany; Italy; Ireland; Austria; India; Sweden; China; Spain; Argentina; Netherlands; Belgium; Norway; Switzerland; Australia; Denmark.

**Justification**

NANOSCIENCE & NANOTECHNOLOGY AND ADVANCED FUNCTIONAL MATERIALS ARE CONSIDERED THE TECHNOLOGICAL PLATFORM OF THE 21ST CENTURY BECAUSE THEY ARE AT THE FRONTIER OF KNOWLEDGE AS WELL AS THE BASIS FOR TECHNOLOGICAL INNOVATIONS. THE NANOMETER SCALE, IN AT LEAST ONE OF THE DIMENSIONS, GIVES PROPERTIES AND

FUNCTIONS TO THE MATERIALS THAT ARE QUITE DIFFERENT FROM THEIR BULK SHAPE. THE SPECIFIC PROPERTIES OF NANOMATERIALS ALLOW A DIVERSITY OF APPLICATIONS IN HIGH TECHNOLOGY DEVICES. IN THIS SENSE, THE DEVELOPMENT OF ADVANCED MATERIALS APPLIED TO ENGINEERING, MEDICINE, COMPUTING AS WELL AS POWER GENERATION AND TRANSMISSION OFTEN EXPLOITS THE PROPERTIES OF NANOSTRUCTURES. A BETTER UNDERSTANDING, DEVELOPMENT, MANIPULATION AND TECHNOLOGICAL APPLICATION OF THIS KNOWLEDGE REQUIRE INTERDISCIPLINARY TRAINING AND PERFORMANCE THAT ENCOMPASSES CHEMISTRY, PHYSICS, BIOLOGY, ENGINEERING, MEDICINE, AND INFORMATION TECHNOLOGY. IN THIS REGARD, ALSO APPLIED HUMAN SCIENCES ALSO PLAY AN IMPORTANT ROLE CONCERNING THE INDISPENSABLE RESPECT TO ETHICAL AND SOCIAL VALUES. IT IS WORTHWHILE TO NOTE THAT THE SIGNIFICANT SCIENTIFIC AND TECHNOLOGICAL ADVANCE ACHIEVED IN THE 20TH AND 21ST CENTURIES CAME FROM THE KNOWLEDGE OF THE STRUCTURE OF MATTER AT THE MOLECULAR, ATOMIC AND SUB-ATOMIC LEVEL, IS AN EMBLEMATIC EXAMPLE OF THE FACT THAT FUNDAMENTAL RESEARCH ESTABLISHES THE BASES OF TECHNOLOGICAL ADVANCE. PARTICULARLY, QUANTUM MECHANICS PROPITIATED A CONCEPTUAL REVOLUTION AND FOUNDED THE SCIENTIFIC BASES THAT SUSTAIN MICROELECTRONICS IN THE TWENTIETH CENTURY. IN THE LAST DECADE'S ADVANCES IN MINIATURIZATION TECHNIQUES, HAVE ENABLED THE CONTROL OF INDIVIDUAL QUANTUM SYSTEMS, CONSTITUTED BY FEW ATOMS, MOLECULES OR PHOTONS. IN THIS SCENARIO, THE SO-CALLED QUANTUM TECHNOLOGIES HAVE BEEN DEVELOPED GROUNDED ON THE FUNDAMENTAL PRINCIPLES OF PHYSICS AND PROMISE DISRUPTIVE CHANGES IN TECHNOLOGICAL PARADIGMS. THIS SO-CALLED "SECOND QUANTUM REVOLUTION" IS THE SUBJECT OF THE THEME PRESENTED HERE. THE SECOND QUANTUM REVOLUTION INVESTIGATES HOW NON-CLASSICAL EFFECTS (SUPERPOSITION, ENTANGLEMENT, NONLOCALITY) PLAY A FUNDAMENTAL ROLE IN ACHIEVING EFFICIENCY AND SAFETY GAINS IN COMMUNICATION PROTOCOLS (QUANTUM COMMUNICATION), INFORMATION PROCESSING CAPACITY (QUANTUM COMPUTATION) OR EVEN PRECISION IN ULTRA-SENSITIVE SENSORS (QUANTUM METROLOGY) WHEN COMPARED TO THEIR CLASSICAL ANALOGS. BEING THE BASIS OF SCIENTIFIC/TECHNOLOGICAL ADVANCES, QUANTUM PHYSICS, STRUCTURE OF MATTER, NANOSCIENCES AND ADVANCED MATERIALS CAN BE CONSIDERED PRIORITY AND STRATEGIC AREAS FOR THE FUTURE OF THE COUNTRY.

## GOALS

### Goal 1

To internationalize the academic-scientific activities of graduate students

#### Description

The goal is to stimulate Ph.D. students to participate in teaching, research and outreach activities in universities and foreign research institutions, enabling them to come into direct contact with what has been built abroad in science and technology. The internationalization project will allow Brazilian students to have academic experience in institutions abroad - with their idiosyncrasies and differences concerning the Brazilian universities - and to improve its conversation, reading, and writing skills in another language

(mainly English). We also expect the development of collaborations and co-authorship in different academic products (papers, book chapters, patents, etc.).

## **Goal 2**

To train professors and researchers in the state-of-art of Physics, Nanosciences, Chemistry and related areas in foreign institutions

### **Description**

The goal is to stimulate post-doctoral periods abroad for the institution's faculty, allowing them to update themselves with the state-of-the-art of their areas of research, and to establish bilateral collaborations with foreign institutions. Here, the goal is also to carry out short-term missions abroad, to finish papers in progress, to participate in teaching and research seminars, and to present the results obtained in the partnerships developed in the Capes-PrInt Institutional Project.

## **Goal 3**

To enable the contact of the faculty and Ph.D. students of UFABC with centers of excellence in Nanosciences and Nanotechnology

### **Description**

The advance of Brazilian science, particularly in the areas of Nanosciences and Nanotechnology, is notorious, especially considering the growing number of papers and citations in recent years. However, the researchers in the area sometimes have few experiences in centers of excellence abroad, particularly graduate students. The contact with foreign facilities expands the possibilities of future collaborations and partnerships. Acting on the frontier of knowledge is crucial to increase the impact of publications and to consolidate Brazilian science on a global scale. Although the faculty of UFABC has already been publishing in some of the best international journals, such as the Perspectives session of Nature Nanotechnology, the exchange with centers of excellence will allow professors and students to raise new collaborations and consolidate existing ones, as well as opening paths for post-doctoral opportunities.

## **Goal 4**

To attract foreign students and researchers to Brazil

### **Description**

One of the goals of the Capes-PrInt Institutional Project is to make the Federal University of ABC a potential partner of foreign institutions and a pole of attraction of foreign students and researchers. We expect that our institutional vocation - to promote teaching, research and outreach activities based on interdisciplinary, excellence and social inclusion - along with a four-year internationalization project and budget availability for missions abroad and scholarships may attract foreign students and researchers. In this sense, Capes-Print will increase our chances of establishing international collaborations and creating, in loco, an organization culture tightly connected to the internationalization process that may definitively insert UFABC in the roll of genuinely global institutions.

**Goal 5**

To allow the contribution of foreign researchers to seminars and Graduate classes

**Description**

The compulsory and optional courses offered in the Graduate Programs provide the fundamental and specific knowledge that the students need to develop their projects. Graduate programs involved in the goal of Advances in Nanosciences, Mathematics, Advanced Materials and Quantum Physics offer high-level content and review courses for their students. However, the participation of foreign researchers able to contribute to specific subjects offers many advantages in the training of students regarding more significant contact with the foreign language, new experiences and work styles, differentiated and culturally diverse view of teaching and learning evaluation. Like the stay in centers of excellence, the contribution of foreign researchers in subject classes and seminars also creates opportunities for students and faculty members to establish new collaborations in their respective areas.

**Theme 3****CHALLENGES OF SUSTAINABILITY FOR THE 21ST CENTURY: ENERGY, TECHNOLOGY, DEVELOPMENT AND FIGHT AGAINST INEQUALITY****Partner countries**

United Kingdom; Norway; U.S; Switzerland; Sweden; Portugal; India; Zimbabwe; Chile; Ireland; Russia; Denmark; Belgium; Germany; Japan; Canada; Tanzania; Mexico; China; Spain; Colombia; Argentina; South Africa; Italy; Ecuador; France; Paraguay; Ghana; Netherlands; Australia; Ukraine.

**Justification**

APPROXIMATELY 2 BILLION PEOPLE ARE CLOSE TO OR BELOW THE POVERTY LINE, LIVING WITH LESS THAN THE MINIMUM NECESSARY TO PRODUCE AND PARTICIPATE IN SOCIAL LIFE. THERE IS A CLEAR ETHICAL CHALLENGE THERE SINCE IT COMES TO ENSURING ESSENTIAL DIGNITY LEVELS AS WELL AS AN ECONOMIC PROBLEM BECAUSE IT MEANS THAT THE POTENTIAL FOR THE REALIZATION OF CULTURAL DEVELOPMENTS AND MATERIALS IS UNDERUSED. INDICATORS OF INEQUALITY HAVE INCREASED IN THE LAST DECADE, WITH THE WEALTHIEST 1% GROUP ACCOUNTING FOR 82% OF ALL GLOBAL WEALTH GENERATED IN 2017. THE UNITED NATIONS ESTIMATES THAT WE HAVE ALREADY EXCEEDED THE 400 PARTS PER MILLION CO<sub>2</sub> MARK IN THE ATMOSPHERE, SUGGESTING A RESURGENCE OF UNFAVOURABLE ENVIRONMENTAL CONDITIONS WITH PROVEN EFFECTS ON BIODIVERSITY EROSION, DECLINING MARINE LIFE, AND POTENTIATION OF CLIMATE CHANGE WITH IMPACTS ON LIVELIHOODS AND PRODUCTIVE PROCESSES (SUCH AS CHANGES IN RAINFALL REGIMES AND THEIR EFFECTS IN THE FORM OF EXTREME EVENTS OR EFFECTS ON AGRICULTURAL CROPS). THE INSEPARABILITY OF PROBLEMS ASSOCIATED WITH THE DEVELOPMENT AGENDA (STABILITY AND ECONOMIC GROWTH, INEQUALITY, HUMAN RIGHTS, SOCIAL WELFARE) AND THE SUSTAINABILITY AGENDA (ENVIRONMENTAL CONSERVATION, ENVIRONMENTAL IMPACTS OF TECHNOLOGIES AND NEW



PROCESSES, RENEWABLE ENERGIES, PLANNING, AND GOVERNANCE) IS EVIDENT. IN ADDITION TO THE SOCIO-ENVIRONMENTAL PERSPECTIVE, THE THEME AIMS TO PROMOTE THE APPROACH OF PROJECTS RELATED TO SYNTHETIC CHEMISTRY, CATALYSIS, PROCESS DEVELOPMENT AND GREEN CHEMISTRY TO PROMOTE THE DEVELOPMENT AND IMPROVEMENT OF PROCESSES USING BIOMASS, BY-PRODUCTS OR INDUSTRIAL WASTE AND AGRICULTURE, ENABLING THE REVALUATION OF WASTE OF DIFFERENT ORIGINS AND CHARACTERISTICS, WITH THE FOLLOWING GOALS: (1) TO PROMOTE TECHNOLOGICAL ADVANCES IN THE USE OF RENEWABLE ENERGY SOURCES, AS WELL AS IN THE OPTIMIZATION OF CURRENT PROCESSES; (2) TO INVESTIGATE THE SUSTAINABLE USE OF NATURAL RESOURCES AND THE REUSE OF WASTE; (3) TO STUDY NEW CATALYSTS WITH POTENTIAL INDUSTRIAL APPLICATION IN PROCESSES THAT OPTIMIZE ENERGY CONSUMPTION; (4) FROM PROCESSES INVOLVING BIOMASS AND ITS DERIVATIVES, TO RESEARCH WAYS OF OBTAINING ORGANIC COMPOUNDS OF SCIENTIFIC AND TECHNOLOGICAL INTEREST; AND (5) TO STIMULATE HUMAN CAPACITY BUILDING AT INTERNATIONAL LEVEL, RAISING THE IMPACT OF BRAZILIAN SCIENTIFIC PRODUCTION IN AREAS OF DEVELOPMENT, TECHNOLOGIES AND SUSTAINABLE PROCESSES.

## GOALS

### Goal 1

To attract foreign students and researchers to Brazil

#### Description

One of the goals of the Capes-PrInt Institutional Project is to make the Federal University of ABC a potential partner of foreign institutions and a pole of attraction of foreign students and researchers. We expect that our institutional vocation - to promote teaching, research and outreach activities based on interdisciplinary, excellence and social inclusion - along with a four-year internationalization project and budget availability for missions abroad and scholarships may attract foreign students and researchers. In this sense, Capes-Print will increase our chances of establishing international collaborations and creating, in loco, an organization culture tightly connected to the internationalization process that may definitively insert UFABC in the roll of genuinely global institutions.

### Goal 2

To study new catalysts with potential industrial application in processes that optimize energy consumption

#### Description

The goal is to investigate the production of efficient and low-cost catalysts, especially those obtained from agro-industrial waste. Catalytic systems for the improvement of industrial processes should consider both the use of biomass residues and strategic minerals (niobium, for example). In this respect, the use of nanotechnology permeates the synthesis of new catalysts. About 90% of the chemical industries use catalysts, both homogeneous and heterogeneous, requiring a constant updating in this specific area of knowledge due to the new technologies, new processes, and always with the need for more active catalysts and more selective according to the specificity of catalytic processes. Catalysis is probably the most significant means of production of modern chemical inputs, accounting for € 1.5 trillion, or 14% of Europe's GDP, also being a science continually evolving to meet the well-being of society, providing comfort, health,

and well-being. Brazil imports annually around US\$ 80 to 150 million in catalysts (annual oscillation against the useful life of the catalytic converter in industrial reactors), and only locally produces in a significant amount the automotive catalyst (approximately US\$ 150 to 180 million) and the catalyst for gasoline production (approximately US\$ 80 million). Almost one hundred different types of catalysts (homogeneous and heterogeneous) are imported annually, which are used in the petroleum refining, petrochemical, chemical, polymer, food, agrochemical, pharmaceutical, and other industries. Through catalytic reactions is that it produces the main chemical and petrochemical raw materials, as well as the main petroleum derivatives in the refining operations.

**Goal 3**

To train professors and researchers in foreign institutions

**Description**

The goal is to stimulate post-doctoral periods abroad for the institution's faculty, allowing them to update themselves with the state-of-the-art of their areas of research, and to establish bilateral collaborations with foreign institutions. Here, the goal is also to carry out short-term missions abroad, to finish papers in progress, to participate in teaching and research seminars, and to present the results obtained in the partnerships developed in the Capes-PrInt Institutional Project.

**Goal 4**

To investigate the sustainable use of natural resources and the reuse of waste

**Description**

The goal is to promote the use of renewable natural and non-edible crop products as well as their industrial waste. This is a desirable option regarding sustainability. The energy issue, in particular of renewable one, should be extensively investigated. The expectation of promoting research both in the improvement of processes related to the production of biofuels and in the rational use of raw materials and use of waste, infer to this proposal conditions to contribute to the development of more integrated and sustainable production systems. Directly or indirectly, we would be favoring an increase in the water, food and energy security of the population.

**Goal 5**

To contact libraries with rare collections in museums and research institutions abroad

**Description**

Although there is currently a vast amount of material available online and much more facility in purchasing books and science journals, to access much of what has been published in the past requires visits to foreign institutions. We expect that the Institutional Internationalization Project will allow Brazilian researchers of the Federal University of ABC and graduate students to contact rare bibliographic material deposited especially in American and European institutions. This will benefit studies concerning biological diversity, climate changes and other aspects of natural sciences, as well as research in philosophy and history of the sciences, aiming at critical and humanistic science education.

**Goal 6**

To research the development of new catalytic systems and new technological routes that add value to oil products and biomass abundant in Brazil

**Description**

The discoveries of the oil deposits in the pre-salt layer place Brazil among the five countries with the highest reserves. Therefore, continuing to invest in research in the petrochemical and energy sector is a guarantee of increasing the added value of domestic production. Partnerships with countries that have advanced technologies in this sector are fundamental to promote the country technologically. On the other hand, currently, all research on the use of fossil fuels has been questioned due to the greenhouse effect. However, Brazil has today the world's cleanest energy matrix, with a high share of renewable fuels and hydropower. Thus, there is still room for research in the petroleum sector, since the resources derived from it can support research with renewable sources. It should be noted that the vast majority of processes involving biomass transformations are not financially viable and require policies to foster their uses. To be economically feasible, Pro-Alcohol had strong subsidies at the beginning, but today it competes with gasoline and is fundamental for the environment. Biodiesel is still subsidized. The cost of raw vegetable oil is often comparable (or higher) than that of diesel (this is also subsidized!). Second-generation ethanol, which uses enzymatic processes for the extraction and hydrolysis of cellulose, still has economic difficulties to maintain. Glycerol has the impurity barrier and high cost of purification. Therefore there are many challenges, but in the biomass sector Brazil is a reference, and the theme should attract renowned researchers, as well as Ph.D. students and postdoctoral students.

**Goal 7**

To internationalize the academic-scientific activities of graduate students

**Description**

The goal is to stimulate Ph.D. students to participate in teaching, research and outreach activities in universities and foreign research institutions, enabling them to come into direct contact with what has been built abroad in science and technology. The internationalization project will allow Brazilian students to have academic experience in institutions abroad - with their idiosyncrasies and differences concerning the Brazilian universities - and to improve its conversation, reading, and writing skills in another language (mainly English). We also expect the development of collaborations and co-authorship in different academic products (papers, book chapters, patents, etc.).

**Goal 8**

To promote technological advances in the use of renewable energy sources, as well as in the optimization of current processes

**Description**

Global industrial and economic development requires a growing number of natural sources and fossils of energy. According to the International Energy Agency (IEA), the variation in net energy consumption from

natural sources between 1973 and 2005 was 3212 Mtoe, corresponding to an increase in CO<sub>2</sub> emissions of 11475 Mtoe. It is estimated that primary energy consumption will increase by approximately 123% between 2003 and 2030, with the contribution of fossil fuels being approximately 88%. The goal is to investigate alternative sources of energy, which have been used to minimize the emission of greenhouse gases and the economic dependence of non-renewable sources. Biomass, currently the most widely used renewable source in the world, is expected to play a key role in replacing fossil fuels in the medium to long-term. It should be noted that in 2008, only 10.2% of the primary energy source provided came from the use of biomass.

#### Theme 4

### INFORMATION AND COMMUNICATION TECHNOLOGIES, COMPLEX SYSTEMS AND SMART APPLICATIONS

#### Partner countries

France; Australia; India; U.S; Germany; Canada; United Kingdom; Italy; Greece; India; Australia; Portugal; Spain; United Kingdom; Belgium; Portugal; Peru; Sweden; New Zealand; Colombia; Chile; Netherlands; Czech republic; Germany; Canada; Spain; China; Spain.

#### Justification

THE FUNDAMENTAL JUSTIFICATION FOR THIS TOPIC IS THE PRODUCTION OF KNOWLEDGE, TRAINING OF HUMAN RESOURCES AT INTERNATIONAL LEVEL AND CONCEPTION OF INNOVATIVE AND INTERDISCIPLINARY SOLUTIONS IN AREAS RELATED TO INFORMATION AND COMMUNICATION TECHNOLOGIES AND COMPLEX SYSTEMS, AS WELL AS THEIR INTERACTIONS WITH DEMANDS FROM SOCIETY, SUCH AS THE IMPROVEMENT OF CITIZENS' QUALITY OF LIFE, AND SUSTAINABILITY. THIS THEME IS ALIGNED WITH THE INNOVATION AGENCY OF THE FEDERAL UNIVERSITY OF ABC (PROPONENT INSTITUTION), AN INITIATIVE OF SCIENTIFIC AND TECHNOLOGICAL INFRASTRUCTURE THAT AIMS TO TRANSCEND BARRIERS BETWEEN ACADEMIC RESEARCH AND TECHNOLOGICAL INNOVATION. IT IS EXPECTED THAT THE KNOWLEDGE GENERATED BY THE PROJECTS RELATED TO THIS THEME WILL HAVE A STRONG INTERACTION WITH THE PRODUCTIVE SECTOR OF THE SOCIETY IN THE PERSPECTIVE OF GENERATING TECHNOLOGICAL INNOVATION, USING A TRANSVERSAL VISION RELATED TO VIRTUALIZATION TECHNOLOGIES (VIRTUAL REALITY AND VIRTUAL WORLDS), MULTIMEDIA (SIGNAL PROCESSING AND APPLICATION DEVELOPMENT), ENTERTAINMENT (COMPUTER GRAPHICS AND GAMES), INTERNET (COMPUTER NETWORKS AND MOBILITY) AND COMPUTING SYSTEMS (HIGH PERFORMANCE COMPUTING AND BIG DATA). ALSO, THE DESCRIPTION OF COMPLEX PHYSICAL AND BIOLOGICAL PHENOMENA CAN BENEFIT FROM MATHEMATICAL MODELING THAT USES DIFFERENTIAL EQUATIONS AND FROM THE USE OF SPECIAL ANALYTICAL TECHNIQUES OR NUMERICAL AND COMPUTATIONAL METHODS - THE MORE REALISTIC A MODEL BECOMES, THE MORE LIKELY IT IS TO INCORPORATE NON-LINEAR EFFECTS. NONLINEAR PHENOMENA ARE QUITE COMMON IN SCIENCE AND ARE A FERTILE FIELD OF RESEARCH WITHIN PURE AND

APPLIED MATHEMATICS, WHICH JUSTIFIES THEIR STUDY WITHIN THE PROPOSED TOPIC. IT ALSO ENCOMPASSES THE INTERDISCIPLINARY FIELD OF DATA-ORIENTED SCIENCE, WHICH INVOLVES SCIENTIFIC METHODS, PROCESSES, AND SYSTEMS CAPABLE OF EXTRACTING KNOWLEDGE AND UNDERSTANDING PHENOMENA USING DATA IN DIFFERENT FORMATS, E.G., STRUCTURED, SEMI-STRUCTURED OR UNSTRUCTURED. FOR THIS PURPOSE, WE HAVE USED TECHNIQUES AND THEORIES IN MATHEMATICS, STATISTICS, COMPUTER SCIENCE, INFORMATION SCIENCE, IN PARTICULAR, THE SUBDOMAINS OF MACHINE LEARNING, PATTERN RECOGNITION, DATA MINING, DATABASES, GRAPHS, AND VISUALIZATION. IT IS AN AREA FOSTERED BY ADVANCES IN INFORMATION TECHNOLOGY AND THE GENERATION OF LARGE DATA VOLUMES.

## GOALS

### Goal 1

Contributing to the advance of Computer Science and its impact on education and learning

#### Description

Advances in Computer Science have made it ubiquitous in society. Interpersonal relationships, work, and education occur with computational supports. However, the pace of progress in the area presents complex challenges that demand quick but efficient responses. In general, a considerable amount of data needs to be analyzed so that these challenges can be addressed appropriately. In this sense, the first challenge arises, which is based on pre-processing and data representations, involving multidimensional databases, complex networks, data mining and the internet of things. It will also explore the use of parallel and high-performance computing in the processing and analysis of massive data. To this end, interdisciplinary approaches will be applied, allowing the interaction between researchers from different areas. Such an approach is essential to obtaining advances in the area since modern data analysis and processing techniques involve areas such as Mathematics, Statistics, Computer Science, Neuroscience and Information Science. A fundamental aspect is a search for a better understanding of areas of Computational Theory such as Combinatorics and Graph Theory, thus enabling the achievement of substantial technological advances supported by a consistent theoretical basis.

### Goal 2

To train professors and researchers in foreign institutions

#### Description

The goal is to stimulate post-doctoral periods abroad for the institution's faculty, allowing them to update themselves with the state-of-the-art of their areas of research, and to establish bilateral collaborations with foreign institutions. Here, the goal is also to carry out short-term missions abroad, to finish papers in progress, to participate in teaching and research seminars, and to present the results obtained in the partnerships developed in the Capes-PrInt Institutional Project.

### Goal 3

To attract foreign students and researchers to Brazil

**Description**

One of the goals of the Capes-PrInt Institutional Project is to make the Federal University of ABC a potential partner of foreign institutions and a pole of attraction of foreign students and researchers. We expect that our institutional vocation - to promote teaching, research and outreach activities based on interdisciplinary, excellence and social inclusion - along with a four-year internationalization project and budget availability for missions abroad and scholarships may attract foreign students and researchers. In this sense, Capes-Print will increase our chances of establishing international collaborations and creating, in loco, an organization culture tightly connected to the internationalization process that may definitively insert UFABC in the roll of genuinely global institutions.

**Goal 4**

Understanding non-linear phenomena with the use of mathematical and numerical models

**Description**

Since the development of the Differential Calculus by Newton and Leibniz in the seventeenth century, differential equations are used to model phenomena and concepts in various areas of knowledge, such as biology, physics, economics, and engineering. The more complex the phenomenon or concept, more non-linear effects tend to emerge from it. In this way, we aim to strengthen the knowledge and to have a better understanding of the nuances of nonlinear mathematical models, thus contributing to the advances of the theoretical study in this area. Another aim is to deepen the study of nonlinear mathematical models for real problems, especially those present in the daily life, such as the proliferation of diseases and epidemics, commonly present in tropical countries. From the point of view of applications of non-linear systems, we aim to get a deep understanding of complex biological phenomena. Precisely, we are interested in modeling biological phenomena related to cancer. Given the complexity of these nonlinear systems, numerical methods will be used to perform computer simulations when necessary. In parallel to the numerical solutions, Lie symmetries, for example, will be used as tools in the search for exact solutions. Finally, focusing on theoretical foundations, the characteristics and particularities of integrable systems will be investigated. More precisely, we will search for a better understanding of evolutionary systems, investigate algebraic and geometric properties of new evolutionary equations, and study mechanical-geometric phenomena of the Ibragimov conservation laws.

**Goal 5**

Bringing the internet of the future and its applications to the city and the countryside

**Description**

The Internet of Things (IoT) has taken several devices to be part of a big network uninterruptedly. Cameras of monitoring systems, sensors installed in vehicles, smartphones, smartwatches, and medical equipment send data and transparently receive instructions. The installation of sensors of multiple natures in urban and rural spaces coupled with the omnipresence of GPS smartphones as well as computational resources available in the cloud allows it to be possible to automate cities and the countryside to improve the quality of life of people, creating smarter societies. The use of many combined technologies, such as IoT, cloud

computing, big data analytics, and network software, enables the construction of a myriad of innovative intelligent applications for the benefit of society.

#### **Goal 6**

To internationalize the academic-scientific activities of graduate students

#### **Description**

The goal is to stimulate Ph.D. students to participate in teaching, research and outreach activities in universities and foreign research institutions, enabling them to come into direct contact with what has been built abroad in science and technology. The internationalization project will allow Brazilian students to have academic experience in institutions abroad - with their idiosyncrasies and differences concerning the Brazilian universities - and to improve its conversation, reading, and writing skills in another language (mainly English). We also expect the development of collaborations and co-authorship in different academic products (papers, book chapters, patents, etc.).

**POSTGRADUATE PROGRAMS LINKED TO THIS PROPOSAL****Theme 1****BIOSYSTEMS AND BIOTECHNOLOGY TOOLS**

<b>Postgraduate Program 1</b>	<b>Capes evaluation (2017 evaluation grade)</b>
SCIENCE AND TECHNOLOGY	5

**Justification**

Due to the interdisciplinary characteristics of UFABC, several studies carried out in the Graduate Program in Science and Technology / Chemistry permeate other areas. Studies of transformation processes should involve several areas to be complete, adding different points of view and knowledge to research. In this theme, studies involving the development and structural characterization of nanoparticles will also depend on the work made by the faculty and students of this Graduate Program. The Program will be directly involved in two projects: "Bioactive compounds and their technological applications in biological systems" and "Development of new drugs and new pharmacotherapeutic approaches for the treatment of human and animal pathologies".

<b>Postgraduate Program 2</b>	<b>Capes evaluation (2017 evaluation grade)</b>
NANOSCIENCES AND ADVANCED MATERIALS	5

**Justification**

In the theme, the faculty and students of the Graduate Program in Nanosciences will work mainly in the project "Bioactive compounds and their technological applications in biological systems", and will be responsible for the study of chemical transformations mediated by biomolecules and their relation with biological processes.

<b>Postgraduate Program 3</b>	<b>Capes evaluation (2017 evaluation grade)</b>
BIOTECHNOSCIENCES	4

**Justification**

In this theme, the faculty and students of the Graduate Program (and their international collaborators) will contribute to four projects. In "Development of tools for the improvement of biotechnological processes applied to the medical field and agroindustry" and "Biotechnology as a powerful tool for the Brazilian Health Service ", they will carry out scientific investigations aiming to increase the knowledge domain about tools that can benefit the Health and Agribusiness services in Brazil, as well as to train human resources with multidisciplinary knowledgeable to teach and disseminate research in this thematic area. In "Development and characterization of high value biotechnological products", they will be responsible for the structural and functional characterization of these bioproducts, as well as for the full evaluation of their biotechnological potential. In the project "Study of cellular and molecular mechanisms involved in the progression and treatment of pathologies of Public Health interest ", the graduate program will contribute to studies of cellular and molecular mechanisms related to the progression of cardiac pathologies. Finally, the Graduate Program's link to the project "New scientific and technological developments in biotechnology" lies in the considerable involvement of biotechnology industries with the academy. According to a survey of biotechnology in Brazil conducted in 2011, 94.5% of biotechnology companies in the country had a close



relationship with universities or research centers. In this regard, recent data also show that we must learn from countries that have a well-established biotechnology industry (e.g., the United States). The Evaluate Pharma consultancy report showed that in 2012 the Biotechnology market in this country represented 47% of the world market. The Graduate Program has accredited researchers linked to the investigation areas related to the management of technology and innovation; the economy of innovation and knowledge and business strategies, thus justifying their participation in the proposed project.

<b>Postgraduate Program 4</b>	<b>Capes evaluation (2017 evaluation grade)</b>
INFORMATION ENGINEERING	4

**Justification**

In this theme, the faculty and students of the Information Engineering Graduate Program will be responsible for studies of structural dynamics, normal modes and molecular dynamics within the scope of the project "Development of New Drugs and New Pharmacotherapeutic Approaches for the Treatment of Human and Animal Pathologies."

<b>Postgraduate Program 5</b>	<b>Capes evaluation (2017 evaluation grade)</b>
BIOSYSTEMS	4

**Justification**

The faculty and students from the Graduate Program will participate actively in four projects related to the theme. In "Development and Characterization of High Value Biotechnological Products", they will use concepts derived from basic research for the development of high value-added bioproducts, an interdisciplinary challenge that relates basic and applied research, enabling the necessary synergy for the development of the cycle research and innovation that permeates current biotechnology. In general, the faculty of the Graduate Program will be responsible for activities involving the production and biological characterization of biomolecules and microorganisms. In "Study of cellular and molecular mechanisms involved in the progression and treatment of pathologies of Public Health interest", the faculty and students of the Graduate Program will conduct the molecular studies related to the development of immunotherapies, drugs and new antitumor targets, to the characterization of cutaneous microbiota and the coding potential of viruses. The study of the cellular and molecular mechanisms involved in the progression of different pathologies is essential for the design of future strategies related to the treatment, prevention, and diagnosis of these pathologies. The wide diversity of research areas involved in this project underscores its multidisciplinary character and the integration among the researchers involved. The project "Development of New Drugs and New Pharmacotherapeutic Approaches for the Treatment of Human and Animal Pathologies" has added international collaborations of professors from several Graduate Programs of UFABC, to constitute a proposal that gathers complementary experiences and points of view on this complex theme. The Graduate Program in Biosystems will contribute with studies involving docking and molecular dynamics analyses of new molecules and their respective targets, as well as in the development of new drug and bioactive carrier systems. The development of new drugs and pharmacotherapeutic strategies is a frontier area, which requires a highly multidisciplinary approach, given the inherent complexity of the topic. Finally, in "Bioactive compounds and their technological applications in biological systems", the Graduate Program will be responsible for the study of chemical transformations mediated by biomolecules and their relation with biological processes.

**THEME 2**

ADVANCES IN NANOSCIENCES, STRUCTURE OF MATTER, QUANTUM PHYSICS AND ADVANCED MATERIALS

Postgraduate Program 1	Capes evaluation (2017 evaluation grade)
MATHEMATICS	4

**Justification**

In this theme, the Graduate Program will participate in activities of the "Challenges of Astrophysics, Cosmology, and Gravitation for the 21<sup>st</sup> century". The faculty and students involved will study, among others, similar models in gravitation. These are non-gravitational physical systems (hydrodynamic, optical, special materials) that reproduce, in specific regimes, the propagation of waves in curved space-times. Analogous black holes can be constructed in the laboratory using, e.g., water. This is a new area of research that encourages the development of technological innovations in non-gravitational physical systems associated.

Postgraduate Program 2	Capes evaluation (2017 evaluation grade)
SCIENCE AND TECHNOLOGY	5

**Justification**

The faculty and students of the Graduate Program will participate in the project "Spectroscopy, spectrometry and computational simulation applied to the study of biomolecules and their interactions with the environment" and "Synthesis, characterization, and simulation of advanced materials". Studies of transformation processes should involve several areas of research to be complete, aggregating different points of view and knowledge to research. This interdisciplinary and multidisciplinary characteristic of UFABC and the Graduate Program in Science and Technology / Chemistry allows subjects to be studied to cover different perspectives. This subject is directly related to the structure of the subject, involving simulation and spectrometric techniques that have a direct relationship with the lines of research from this Graduate Program.

Postgraduate Program 3	Capes evaluation (2017 evaluation grade)
PHYSICS	5

**Justification**

In this theme, faculty and students of the Graduate Program in Physics will be especially related to the activities of the projects "Fields and Particle Physics: discoveries and innovations for a new millennium", "Disruptive advances in Quantum Technology: Technological development and strategic innovation for the 21st century", "Challenges of Astrophysics, Cosmology and Gravitation for the 21st Century": Several professors from this Graduate Program work in the area of Particles and Fields, and are naturally linked to this project: about five theoretical researchers and five experimental researchers, not counting other researchers physics not yet linked to post-graduation. We emphasize that many researchers of this Graduate Program already have collaborations abroad, being co-authors in several publications; experimental researchers participate in several of the international collaborations to carry out the great experiments mentioned in the description. Regarding gravitational studies, the involved researchers investigate, among others, similar models in gravitation. These are non-gravitational physical systems

(hydrodynamic, optical, special materials) that reproduce, in specific regimes, the propagation of waves in curved space-times. Analogous black holes can be constructed in the laboratory using, e.g., water. This is a new area of research that encourages the development of technological innovations in non-gravitational physical systems associated.

Postgraduate Program 4	Capes evaluation (2017 evaluation grade)
NANOSCIENCES AND ADVANCED MATERIALS	5

#### Justification

In the theme, the Graduate Program will participate directly in the projects "Advanced Materials for Structural and Functional Applications", "Advanced Materials: Fundamental and Applied Studies", "Synthesis, characterization and simulation of advanced materials" and "Spectroscopy, spectrometry and computational simulation applied to the study of biomolecules and their interactions with the environment". The faculty and students of the Graduate Program and their respective foreign collaborators will develop theoretical and experimental activities according to their expertise in the areas of synthesis, characterization, and simulation of advanced functional and structural materials. Studies involving simulation and spectrometric techniques will also be the focus of professors and students of the Graduate Program.

#### THEME 3

CHALLENGES OF SUSTAINABILITY FOR THE 21ST CENTURY: ENERGY, TECHNOLOGY, DEVELOPMENT AND FIGHT AGAINST INEQUALITY

Postgraduate Program 1	Capes evaluation (2017 evaluation grade)
HUMAN AND SOCIAL SCIENCES	4

#### Justification

The participation of the Graduate Program will be connected to the projects "Development Challenges of the Southern Hemisphere for the 21st Century", "Human Rights: from theoretical foundations to contemporary trends at the local level (cities)" and "Latin America after the international financial crisis: state, economy and society". The Graduate Program, from its conception, is systematically devoted to the interdisciplinary study of economic and social development. In particular, the Research Lines "Economy, Development, and Society" and "State, Public Policies, and Civil Society" have focused on social, economic, political and technological aspects of development, with contributions published in national and international journals. Also, due to its preoccupation with technology issues, the program has also contributed to the strengthening of the dialogue between the Human and Exact Sciences in UFABC, aiming at breaking the barriers that still exist in many areas between the so-called "hard sciences" and the humanities.

Postgraduate Program 2	Capes evaluation (2017 evaluation grade)
SCIENCE AND TECHNOLOGY	5

#### Justification

In this eminently interdisciplinary theme, the faculty and students of the Graduate Program in Science and Technology / Chemistry will participate especially in projects related to the development of new sustainable processes and technologies, linked to Green Chemistry and related issues, chemical transformations and clean energy, studying benefits for understanding fundamental phenomena related to chemical and physical

processes involved in energy conversion. The faculty and students of the Graduate Program will work in the framework of the projects "Catalytic and electrocatalytic transformations to obtain energy and higher added value products from biofuels and derivatives", "Optimization of transformation processes aiming technological advances in analytical methodologies and preparation of nanoparticles and electrocatalysts" and "Sustainable Energy Storage and Production". The participation of the Graduate Program in this theme will also contribute to the discussion of the social impact of the technological development coming from activities of the "hard sciences".

<b>Postgraduate Program 3</b>	<b>Capes evaluation (2017 evaluation grade)</b>
TERRITORY MANAGEMENT AND PLANNING	4

#### **Justification**

The Graduate Program will participate in the activities of the project "Planning and Governance for sustainable metropolitan Regions in Latin America and Europe in the context of climate changes". The proposal aims to integrate projects under development with international networks that focus on the debate on planning and territorial management, with emphasis on the issues of sustainable development of the metropolises in the face of climate change, the theme that these institutions present in their lines of research in both the undergraduate and graduate teaching.

<b>Postgraduate Program 4</b>	<b>Capes evaluation (2017 evaluation grade)</b>
NANOSCIENCES AND ADVANCED MATERIALS	5

#### **Justification**

The faculty and students of the Graduate Program will participate in the projects "Nanoscience for Environmental Preservation and Recovery", "Sustainable Energy Storage and Production", "Optimization of transformation processes aiming technological advances in analytical methodologies and preparation of nanoparticles and electrocatalysts", and "Catalytic and electrocatalytic transformations to obtain energy and higher added value products from biofuel and oil derivatives". The Graduate Program will contribute in the area of nanotechnology regarding development and choice of nanoparticles in function of their different characteristics and functionalities, being able to be metallic, magnetic and biopolymeric (natural and synthetic). These nanoparticles will be studied concerning functionalization with organic compounds, such as association with essential oils, to act in the removal of different contaminants from the water, either in the process of bioremediation or bioaugmentation, as in the treatment of effluents. The researchers will also be responsible for the development of new materials researching their fundamental properties both experimentally and theoretically. Advances in understanding these new nanometric materials could be used to manufacture high-performance devices for the conversion and storage of alternative and sustainable energy. Still, the faculty and students of the Graduate Program will participate in the synthesis of nanoparticles and characterization of these materials.

#### **THEME 4**

INFORMATION AND COMMUNICATION TECHNOLOGIES, COMPLEX SYSTEMS AND INTELLIGENT APPLICATIONS

Postgraduate Program 1	Capes evaluation (2017 evaluation grade)
MATHEMATICS	4

**Justification**

The Graduate Program will participate in the projects "Non-linear phenomena in analysis, physics and biology" and "Combinatorics and applications in Bioinformatics, Scientometrics, and Computer Graphics", working in mathematical modelling, as well as the application of such models in real problems (and in the public interest) of Physics and Biology (especially in Biomathematics), besides being responsible for theoretical advances in combinatorics and graphs.

Postgraduate Program 2	Capes evaluation (2017 evaluation grade)
BIOSYSTEMS	4

**Justification**

In the project "Combinatorics and applications in Bioinformatics, Scientometrics, and Computer Graphics", the faculty and students of the Graduate Program will be responsible mainly for the studies of the applications and validation of the results of the mathematical modeling to the problems related to Bioinformatics.

Postgraduate Program 3	Capes evaluation (2017 evaluation grade)
INFORMATION ENGINEERING	4

**Justification**

The faculty and students of the Graduate Program, as well as their international collaborators, will actively participate in four projects related to the theme. The project "Optical Networks for the Future Internet and Advanced Applications" is aligned with the areas of concentration of Information Networks and Intelligent Systems of the Program. In "IoT-based Applications for Smart Cities and Smart Farming", the Graduate Program will contribute to the development of activities related to network technologies, protocols, sensors, and actuators. In "Data Science", they will be responsible for the investigation of processes and techniques, especially those related to the internet of things, agricultural and intelligent cities. Finally, in the project "Combinatorics and applications in Bioinformatics, Scientometrics, and Computer Graphics", The Graduate Program will participate in the development of processes and techniques of modeling and prediction of the conformation of protein structures.

Postgraduate Program 4	Capes evaluation (2017 evaluation grade)
NEUROSCIENCE AND COGNITION	4

**Justification**

The faculty and students of the Graduate Program will participate in different projects. In "Data Science", they will study possible applications and validation of the results related to the problems of Neuroscience and Cognition. In the project "Development and Evaluation of Innovative Technologies to Mediate Learning", since learning occurs through many forms of cognitive behaviour, it is important to investigate how the learning process occurs in the brain, as well as to test, evaluate and validate computational platforms of learning through cognitive experiments with humans - in this sense, the participation of members of the Graduate Program in Neuroscience and Cognition is justified. Still, in the project "Combinatorics and applications in Bioinformatics, Scientometrics, and Computer Graphics", the faculty of the Graduate Program

will be responsible for the applications and validation of results related to Bioinformatics problems, involving analysis of molecular biology data of neurodevelopment disorders and neurodegeneration.

Postgraduate Program 6	Capes evaluation (2017 evaluation grade)
TERRITORY MANAGEMENT AND PLANNING	4

#### Justification

The Graduate Program will participate in the theme in the project "Data Science". Since its faculty and students (as well as international collaborators) deal with research projects in urban planning, land use assessment, geoprocessing, and spatial analysis. The faculty of the Graduate Program can provide a solid foundation to support the use of results from real-life case studies, including improving community resilience against natural disasters, and mobility to address urban issues to determine government policies.

Postgraduate Program 7	Capes evaluation (2017 evaluation grade)
HUMAN AND SOCIAL SCIENCES	4

#### Justification

The faculty of the Graduate Program will participate in three projects related to the theme. In the "Data Science" project, they will be responsible for the applications and validation of the results related to the problems involving political analysis, feelings, and social networks. In "Development and Evaluation of Innovative Technologies to Mediate Learning", will participate in the investigation of educational theories and proposition of educational guidelines for the development of educational tools; pedagogical evaluation of the application of technologies in learning processes and their potentialities and challenges for efficient mediation of learning. Finally, in the project "IoT-based Applications for Smart Cities and Smart Farming", the Graduate Program will be in charge of the development of activities related to social and human impacts related to the automation of activities related to IoT technologies.

Postgraduate Program 8	Capes evaluation (2017 evaluation grade)
COMPUTER SCIENCES	4

#### Justification

The faculty of the Graduate Program will participate in the projects "Data Science", "Development and evaluation of innovative technologies to mediate learning", "Combinatorics and applications in Bioinformatics, Scientometrics and Computer Graphics", "Optical Networks for the Future Internet and Advanced Applications", and "IoT-based Applications for Smart Cities and Smart Farming". These projects not only cover theoretical and practical aspects of Computer Science but also provide a very solid interdisciplinary interface with several other Graduate Programs. In this sense, the faculty and students of the program will be responsible for the theoretical basis, mathematical analysis, and computational modeling and development (implementation) of the techniques. Multi and interdisciplinary applications will also be targeted, among them the investigation and application of computational processes and technologies in the development of educational tools. In this sense, we will explore the state-of-the-art of several areas of Computer Science, for example, software engineering (processes), artificial intelligence (adaptive mechanisms, personalization, pattern discovery, knowledge representation), computer graphics and visualization.

Postgraduate Program 1	Capes evaluation (2017 evaluation grade)
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**Justification**

In this theme, the Graduate Program will contribute to the activities of the project "Combinatorics and applications in Bioinformatics, Scientometrics, and Computer Graphics", especially in the study of applications related to the themes of Van der Waals interactions, nuclear quantum effects in hydrogen bonds, molecular dynamics, ab initio and quantum physics.

**ACTIVITIES LINKED TO THE THEMES****Theme 1****BIOSYSTEMS AND BIOTECHNOLOGY TOOLS****Goal 1**

To enable the contact of UFABC students and professors with companies and research groups overseas where the transfer of academic knowledge to industries is nowadays a reality

Activity	Start date	End date
Enable collaboration and contact of our students with companies overseas	03/2019	03/2022

**Description**

Provide the contact of UFABC students with companies in the framework of biotechnology (and related areas) and research groups in countries where the collaborations between Universities and companies are more advanced, particularly during their Ph.D. (sandwich Ph.D.).

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Number of students with collaborations with companies abroad	Sporadic collaborations	At least half of students with projects related to the area collaborating with biotechnology companies	All students with projects related to the area collaborating with biotechnology companies

Activity	Start date	End date
Provide missions abroad for professors	03/2019	03/2022

**Description**

Through short-term visits (15-45 days), this will allow the contact of the professors with companies in the framework of biotechnology (and related areas) and research groups in countries where the collaborations between Universities and companies are more advanced.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of visits	Sporadic, depending	At least half of the	The whole UFABC



of researchers from UFABC to companies abroad	on individual partnerships and funding	UFABC working in the theme participating in a mission to a biotechnology company abroad	faculty in a company abroad	faculty members working in the theme participating in a mission to a biotechnology company abroad
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**Goal 2**

To promote scientific advances within the framework of genetic therapies

Activity	Start date	End date
Establish collaborations with research groups overseas that deal with genetic therapies and related areas	03/2019	03/2022

**Description**

Allow the UFABC staff (professors and students) to contact international research groups that embrace investigations on genetic therapies including monogenic diseases, cancer, Parkinson's disease, among others.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of published papers	10	20	40

**Goal 3: To internationalize the academic-scientific activities of graduate students**

Activity	Start date	End date
To stimulate the participation of PhD students in congresses abroad	03/2019	03/2022

**Description**

To allow Ph.D. students from UFABC to go to events abroad - congresses, symposiums, and seminars - presenting their research results; this will enhance contacts with foreign researchers and other graduate students, as well as the development of collaborations and co-authorship.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of Ph.D. students from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on funding from their supervisors	At least half of the Ph.D. students working in the theme participating in a scientific event abroad	The whole Ph.D. students group from UFABC working in the theme participating in a scientific event abroad



**Goal 4: To train professors and researchers in foreign institutions**

Activity	Start date	End date
Organize short missions for project development	03/2019	03/2022

**Description**

Allow Brazilian professors and researchers to visit research and teaching institutions abroad through 15-30 days missions. The main aim is to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

**Indicator 1**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of visits of researchers from UFABC to institutions abroad	Sporadic, depending on individual partnerships and funding	At least half of the UFABC faculty working in the theme participating in a mission abroad	The whole UFABC faculty members working in the theme participating in a mission abroad

Activity	Start date	End date
To stimulate the participation of Brazilian professors in congresses abroad	03/2019	07/2022

**Description**

To allow UFABC faculty members to go to events abroad - congresses, symposiums, and seminars - presenting their research results; this will enhance contacts with foreign researchers and the development of collaborations and co-authorship.

**Indicator 1**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of researchers from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on individual funding and partnerships	At least half of the UFABC faculty working in the theme participating in a scientific event abroad	The whole UFABC faculty members working in the theme participating in a scientific event abroad

**Goal 5: To attract foreign students and researchers to Brazil**

Activity	Start date	End date
To bring doctoral students from abroad to develop projects in collaboration	03/2019	07/2022

**Description**

The aim is to bring graduate students from institutions abroad for working periods in UFABC. We expect these students will collaborate in projects, use laboratory and university facilities, and produce papers in co-authorship.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of foreign graduate students coming to UFABC	0	2	4

Activity	Start date	End date
Organize short missions for project development	03/2019	03/2022

**Description**

Through 15-30 days missions, to receive foreign professors and researchers aiming to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of missions from foreign partners to UFABC	Sporadic, depending on individual partnerships and funding	To receive at least two foreign researchers at UFABC (one per year)	To receive four foreign researchers at UFABC (one per year)

**Theme 2**

ADVANCES IN NANOSCIENCES, STRUCTURE OF MATTER, QUANTUM PHYSICS AND ADVANCED MATERIALS

**Goal 1: To internationalize the academic-scientific activities of graduate students**

Activity	Start date	End date
To stimulate the participation of Brazilian Ph.D. students in congresses abroad	03/2019	03/2022

**Description**

To allow Ph.D. students from UFABC to go to events abroad - congresses, symposiums and seminars - presenting their research results; this will enhance contacts with foreign researchers and other graduate students, as well as the development of collaborations and co-authorships.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of Ph.D. students from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on funding from their supervisors	At least half of the Ph.D. students working in the theme participating in a scientific event abroad	The whole Ph.D. students group from UFABC working in the theme participating in a scientific event

abroad

Activity	Start date	End date
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To allow doctoral students the possibility of collaborating with laboratories and high-performance experimental facilities	03/2019	07/2022
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**Description**

For Ph.D. students in physics and related areas, the access to international laboratories and facilities can greatly contribute to the increase of national scientific-technological competitiveness through the transfer of knowledge and techniques to the groups of UFABC.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Number of Ph.D. students collaborating in laboratories and facilities abroad	Sporadic, depending on individual partnerships and funding	At least ¼ of the Ph.D. students collaborating with international laboratories and research facilities abroad	At least half of the Ph.D. students collaborating with international laboratories and research facilities abroad

**Goal 2**

To train professors and researchers in the state-of-art of Physics, Nanosciences, Chemistry and related areas in foreign institutions

Activity	Start date	End date
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To stimulate the participation of Brazilian professors in congresses abroad	03/2019	07/2022
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**Description**

To allow UFABC faculty members to go to events abroad - congresses, symposiums and seminars - presenting their research results; this will enhance contacts with foreign researchers and the development of collaborations and co-authorships.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of researchers from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on individual funding and partnerships	At least half of the UFABC faculty working in the theme participating in a scientific event abroad	The whole UFABC faculty members working in the theme participating in a scientific event abroad

Activity	Start date	End date
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Organize short missions for project development	03/2019	03/2021
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**Description**

Allow Brazilian professors and researchers to visit research and teaching institutions abroad through 15-30 days missions. The main aim is to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of visits of researchers from UFABC to institutions abroad	Sporadic, depending on individual partnerships and funding	At least half of the UFABC faculty working in the theme participating in a mission abroad	The whole UFABC faculty members working in the theme participating in a mission abroad

Activity	Start date	End date
Opportunity of access to experimental high performance facilities abroad	03/2019	07/2022

**Description**  
The exchange will enable the faculty to access international experimental facilities and high performance laboratories. This access will contribute to obtain relevant and high impact results and technological know-how to UFABC research groups. The projects of the area still contemplate the possibility of accessing data of large experiments, astrophysical observations and computer clusters for large simulations. We believe that experience and training in these international facilities should contribute strongly to the national scientific-technological competitiveness through the transfer of knowledge and techniques to our research groups. Finally, it is worth mentioning that some scientific challenges require supranational efforts to be overcome.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of visits of researchers from UFABC to high performance labs abroad	Sporadic, depending on individual funding	At least half of the UFABC faculty working in the theme visiting or collaborating in high performance labs	All of the UFABC faculty working in the theme visiting or collaborating in high performance labs

**Goal 3**  
To enable the contact of the faculty and Ph.D. students of UFABC with centers of excellence in Nanosciences and Nanotechnology

Activity	Start date	End date
Opportunity to stay for different periods in Universities and Research Centers abroad	03/2019	07/2022

**Description**  
Our projects involve partnerships with researchers of centers of excellence such as International Research Center for Renewable Energy, Copenhagen University, Denmark, Columbia University, The University of North Carolina, Chapel Hill CNRS, France, Laboratoire de Simulation Atomistique CEA, Grenoble, Hiroshima University, among others. Although there is already a partnership with several of the centers indicated, the stay of students has been limited by the availability of funds, which is expected to be supplied by the Print-CAPES project.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal

**Goal 4: To attract foreign students and researchers to Brazil**

Activity	Start date	End date
Organize short missions for project development	03/2019	03/2022

**Description**

Through 15-30 days missions, to receive foreign professors and researchers aiming to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

**Indicator 1**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of missions from foreign partners to UFABC	Sporadic, depending on individual partnerships and funding	To receive at least two foreign researchers at UFABC (one per year)	To receive four foreign researchers at UFABC (one per year)

**Goal 5**

To allow the contribution of foreign researchers to seminars and Graduate classes

Activity	Start date	End date
Lectures and seminars taught by foreign researchers in subject classes and lecture cycles of the Graduate Programs	03/2019	07/2022

**Description**

Our projects involve partnerships with researchers from centers of excellence abroad with expertise and contributions at the frontier of knowledge. Such researchers can bring excellent content and new approaches in teaching and learning assessment.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Foreign professors in Graduate classes	Many of the foreign researchers indicated in the project are already in active partnerships with the faculty members of UFABC	Foreign researchers in half of the seminars and at least one discipline of the Graduate Program in Nanosciences.	Foreign researchers in all of the seminars and at two or three disciplines of the Graduate Program in Nanosciences.

**Theme 3**

CHALLENGES OF SUSTAINABILITY FOR THE 21ST CENTURY: ENERGY, TECHNOLOGY, DEVELOPMENT AND FIGHT AGAINST INEQUALITY

**Goal 1**

To attract foreign students and researchers to Brazil

Activity	Start date	End date
Organize short missions for project development	03/2019	03/2022

**Description**

To receive foreign professors and researchers for 15-30 days missions aiming to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of missions from foreign partners to UFABC	Sporadic, depending on individual partnerships and funding	To receive at least two foreign researchers at UFABC (one per year)	To receive four foreign researchers at UFABC (one per year)

**Goal 2**

To study new catalysts with potential industrial application in processes that optimize energy consumption

Activity	Start date	End date
Investigate ways of obtaining catalysts	03/2019	07/2022

**Description**

Investigate the production and modifications in the way of obtaining catalysts. The goal is to investigate the production of efficient and low cost catalysts, especially those obtained from agro-industrial waste.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of catalysts prepared by year	1	2	4

**Goal 3**

To train professors and researchers in foreign institutions

Activity	Start date	End date
Organize short missions for project development	03/2019	03/2022

**Description**

Allow Brazilian professors and researchers to visit research and teaching institutions abroad through 15-30 days missions. The main aim is to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

**Indicator 1**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of visits of researchers from UFABC to institutions abroad	Sporadic, depending on individual partnerships and funding	At least half of the UFABC faculty working in the theme participating in a mission abroad	The whole UFABC faculty members working in the theme participating in a mission abroad

Activity	Start date	End date
To stimulate the participation of Brazilian professors in congresses abroad	03/2019	07/2022

**Description**

To allow UFABC faculty members to go to events abroad - congresses, symposiums and seminars - presenting their research results; this will enhance contacts with foreign researchers and the development of collaborations and co-authorships.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of researchers from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on individual funding and partnerships	At least half of the UFABC faculty working in the theme participating in a scientific event abroad	The whole UFABC faculty members working in the theme participating in a scientific event abroad

**Goal 4**

To investigate the sustainable use of natural resources and the reuse of waste

Activity	Start date	End date
To study the use of renewable natural products	03/2019	07/2022

**Description**

The goal is to promote the use of renewable natural and non-edible crop products as well as their industrial waste.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of renewable products studied by year	1	2	4

**Goal 5**

To contact libraries with rare collections in museums and research institutions abroad

Activity	Start date	End date		
To organize missions for research in libraries collections abroad	03/2019	07/2022		
Description				
To allow, through 15-30 days missions, Brazilian professors and researchers to visit libraries abroad aiming to develop projects in collaboration, research in book collections, and finalization of papers in co-authorship.				
Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of visits of researchers from UFABC to libraries abroad	Sporadic, depending on individual partnerships and funding	At least half of the UFABC faculty working in the theme and interested in foreign bibliographic collections visiting libraries abroad	The whole UFABC faculty members working in the theme and interested in foreign bibliographic collections visiting libraries abroad

**Goal 6**

To research the development of new catalytic systems and new technological routes that add value to oil products and biomass abundant in Brazil

Activity	Start date	End date		
To attract researchers with high scientific output and academic prominence, as well as Ph.D. students and postdoctoral students, for short missions	03/2019	07/2022		
Description				
To send doctoral students to the US and Europe seeking contact with the petrochemical and biomass sectors for a doctorate sandwich; to receive postdoctoral students and researchers with experience and relevant scientific production for missions of short duration (1 month) in Brazil in the area of biomass transformation.				
Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of post-doctorates coming to UFABC	0	1	2
Quantitative	Number of Ph.D. students send to USA and Europe	0	4	8
Quantitative	Number of foreign professors and researchers coming to UFABC	0	2	4

**Goal 7**



To internationalize the academic-scientific activities of graduate students

Activity	Start date	End date		
To stimulate the participation of Brazilian Ph.D. students in congresses abroad	03/2019	03/2022		
Description				
To allow Ph.D. students from UFABC to go to events abroad - congresses, symposiums and seminars - presenting their research results; this will enhance contacts with foreign researchers and other graduate students, as well as the development of collaborations and co-authorships.				
Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of Ph.D. students from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on funding from their supervisors	At least half of the Ph.D. students working in the theme participating in a scientific event abroad	The whole group of Ph.D. students from UFABC working in the theme participating in a scientific event abroad

#### Goal 8

To promote technological advances in the use of renewable energy sources, as well as in the optimization of current processes

Activity	Start date	End date		
Investigate new processes involving renewable sources	03/2019	07/2022		
Description	Proposition of new processes and investigation of alternative sources of energy, used with the purpose of minimizing the emission of greenhouse gases and the economic dependence of non-renewable sources			
Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of new processes described by year	0	1	2

Activity	Start date	End date
To investigate existing processes, seeking to improve them	03/2019	03/2022
Description		
Proposition of process modifications and investigation of alternative sources of energy, which have been used with the aim of minimizing the emission of greenhouse gases and the economic dependence of non-renewable sources		

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of processes studied by year	1	4	8

**Theme 4**

INFORMATION AND COMMUNICATION TECHNOLOGIES, COMPLEX SYSTEMS AND SMART APPLICATIONS

**Goal 1**

Contributing to the advance of Computer Science and its impact on education and learning

Activity	Start date	End date
Analysis and development of algorithms	03/2019	07/2022

**Description**

To develop and analyze efficient algorithms that deal with problems in Bioinformatics, Neuroscience, Scientometry and Computer Graphics. In addition, the analysis of complex networks has great potential to allow a better understanding of phenomena in social networks, neural networks, among others.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Development of computational methods	In progress	At least five computational methods that deal with problems related to the topic	At least ten computational methods that deal with problems related to the topic

Activity	Start date	End date
Development of educational objects	03/2019	07/2022

**Description**

Essential for a society with broad educational background, educational objects and means will be developed to make the learning process more efficient and comprehensive. We will propose methods, techniques, processes and interaction paradigms for education and learning through the use of new technologies.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Production of technological tools for education and learning	Sporadic projects in progress	At least five educational objects fully working	At least ten educational objects fully working

**Goal 2**

To train professors and researchers in foreign institutions

Activity	Start date	End date
To stimulate the participation of Brazilian professors in congresses abroad	03/2019	07/2022

**Description**

To allow UFABC faculty members to go to events abroad - congresses, symposiums and seminars - presenting their research results; this will enhance contacts with foreign researchers and the development of collaborations and co-authorships.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of researchers from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on individual funding and partnerships	At least half of the UFABC faculty working in the theme participating in a scientific event abroad	The whole UFABC faculty members working in the theme participating in a scientific event abroad

Activity	Start date	End date
Organize short missions for project development	03/2019	03/2022

**Description**

Allow Brazilian professors and researchers to visit research and teaching institutions abroad through 15-30 days missions. The main aim is to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of visits of researchers from UFABC to institutions abroad	Sporadic, depending on individual partnerships and funding	At least half of the UFABC faculty working in the theme participating in a mission abroad	The whole UFABC faculty members working in the theme participating in a mission abroad

**Goal 3**

To attract foreign students and researchers to Brazil

Activity	Start date	End date
Organize short missions for project development	03/2019	03/2022

**Description**

Through 15-30 days missions, to receive foreign professors and researchers aiming to develop projects in collaboration, use of university and laboratory research facilities, and finalization of papers in co-authorship.

Indicator				
Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of missions from	Sporadic, depending on individual	To receive at least two foreign	To receive four foreign researchers

foreign partners to UFABC	partnerships and funding	researchers at UFABC (one per year)	at UFABC (one per year)
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**Goal 4**

Understanding non-linear phenomena with the use of mathematical and numerical models

Activity	Start date	End date
To propose, analyze and apply non-linear models	08/2018	07/2022

**Description**

To propose and analyze non-linear models, and apply them to real life problems, e.g., in the areas of Health and Biology.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of published papers in high-impact journals	1	2	4

**Goal 5:**

Bringing the future internet and its applications to the city and the countryside

Activity	Start date	End date
Development of intelligent technologies	03/2019	03/2022

**Description**

Development of intelligent technologies for urban and rural environments, the latter focusing on the efficient use of resources, such as water, pesticide and energy, in order to develop, deploy and test 1) technologies, protocols, services and platforms related to IoT; 2) data storage and processing technologies that combine cloud and computational haze; 3) concepts and technologies of network software; 3) algorithms, techniques and approaches for decision making from the immense amount of IoT-based application data; 4) distributed systems development techniques and approaches, and data modelling for intelligent IoT-based applications.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Quantitative	Number of published papers in high-impact journals	0	4	8

**Goal 6**

To internationalize the academic-scientific activities of graduate students

Activity	Start date	End date
To stimulate the participation of Brazilian Ph.D. students in congresses abroad	03/2019	03/2022

**Description**

To allow Ph.D. students from UFABC to go to events abroad - congresses, symposiums, and seminars - presenting their research results; this will enhance contacts with foreign researchers and other graduate students, as well as the development of collaborations and co-authorship.

**Indicator**

Type	Indicator	Current situation	Goal for the 2nd year	Final goal
Qualitative	Frequency of Ph.D. students from UFABC participating in scientific events abroad	Sporadic, depending on funding from UFABC Office of Graduate Studies and on funding from their supervisors	At least half of the Ph.D. students working in the theme participating in a scientific event abroad	The whole group of Ph.D. students from UFABC working in the theme participating in a scientific event abroad

**STRATEGIES****Strategy for the consolidation of existing international partnerships, as well as the construction of new partnerships and cooperation projects to increase the relationship between the Brazilian institution and research groups abroad.**

In consonance with UFABC's Institutional Plan of Internationalization, the following strategies for strengthening international partnerships and establishing new ones stand out: (1) Fostering of UFABC's insertion into academic, scientific and outreach international communities. (2) Facilitation of institutional representation in international events on Education both in Brazil and abroad, which can provide the promotion of UFABC for potential international partners. (3) Organization and participation in promotion missions in foreign countries. (4) International promotion of the knowledge produced at UFABC by participation in international cooperation events and organizations. (5) Maintenance of an International Relations Committee as a decision-making instance, as well as a consulting forum for issues related to internationalization. (6) Increasing the number of research projects in collaboration with universities and research centers abroad as a way to facilitate the mobility of the faculty and students between UFABC and foreign universities. (7) Promotion of international cooperation between institutions that carry out outreach activities in educational, productive, and communal environments. (8) Creation of mechanisms for UFABC to absorb the knowledge acquired by members of its community in international experiences. (9) Widening of cooperation agreements with foreign universities, guaranteeing effective cooperation projects and academic exchanges. (10) Creation of an administrative area to provide services and support (financially, logistically and operationally) the submission, monitoring, and accountability of international agencies. (11) Publishing of calls for proposals to provide initial resources (seed money) specifically for the development of projects with international collaboration. (12) Increasing the number of projects submitted for International Exchange Public Notices of funding agencies. (13) Stimulating the submission of proposals for international collaboration and international mobility programs.

**Strategy to attract foreign students to Brazil.**

The search for foreign students is envisaged in many of the strategies presented in UFABC's Institutional Plan of Internationalization. They are, specifically: (1) Developing and maintaining a website and flyers in English to attract international partners. (2) Providing logistic support and physical space to welcome foreign researchers and students in short-term visits for collaboration in projects. (3) Increasing the recruitment of foreign students and researchers for undergraduate, graduate and postdoctoral programs. (4) Stimulating the establishment of double degree agreements for undergraduate and graduate programs, as well as for doctoral thesis cotutelle agreements. (5) Creating experiences of curricula integration with foreign programs, including double-degree. (6) Establishing an annual offer of courses taught in English in undergraduate and graduate programs to enable foreign students who do not speak Portuguese to study at UFABC. (7) Creating new courses, or adapting and translating existing courses into foreign languages.

**Strategy to attract faculty and researchers with international experience.**

(1) Positively evaluate of international experience and foreign language skills as criteria for faculty selection public notices. (2) Publicize public selection notices for in-house and visiting professors both in English and Portuguese. (3) Make the English version of public selection notices available on UFABC's website, as well

as in websites like Nature, FAPESP, and ResearchGate. (4) Provide the validation of diplomas for foreign professors hired by UFABC. (5) Propose specific calls for senior researchers with international experience to perform on graduate programs.

**Strategy to prepare the scholarship holders for the period abroad as well as for their return, especially in order to increase the knowledge appropriation by the institution.**

UFABC's Institutional Plan of Internationalization establishes the following strategies for preparing students and the faculty before their time abroad: (1) Expanding the language courses offered for the university community, increasing the number of students, levels and languages taught (prioritizing English). (2) Offering qualification courses for professors who teach in English. (3) Implementing the Language Center with specific physical space and support of administrative collaborators. Concerning the period after the experiences abroad, the following strategies stand out: (1) Providing institutional support for the establishment of long-term partnerships with foreign institutions. (2) Raising initiatives together with Graduate Programs to disseminate the experiences that students and the faculty have had abroad by doing seminars and workshops such as UFABC's International Week, where students, professors, and collaborators will be able to report their experiences abroad.

**Describe innovative strategies that will be used by the institution that were not mentioned above.**

(1) The stimulus of mobility of different graduate programs students: UFABC's academic-scientific structure, as described in the "Innovative Policies" section, facilitates graduate students to take subjects in different courses, which stimulates the development of interdisciplinary projects, and the enrichment of their academic qualification. Interdisciplinarity, which guides all UFABC's policies, enables integrative propositions, stemming from different points-of-view, for the solution of complex problems. (2) Making use of UFABC's Strategic Research Units to foster research projects that have interdisciplinary, multidisciplinary and transdisciplinary characteristics, and turn them into attractive proposals for international collaborators. (3) With the Academic Industrial Ph.D. and the Entrepreneurial-Academic Master's, fostering partnerships with multinational companies that have Science, Technology, and Innovation Centers abroad which can make possible for students to participate in sandwich periods abroad or technical visits. Both Programs envisage the development of projects in which graduate students can carry out part of their research in the company's headquarters located abroad. To widen this action, a partnership agreement with UA Ruhr is under discussion, a strategic alliance with the best three public universities in the Ruhr region, in Germany. Having a strong orientation towards interaction with regional and national industries, this partnership with UA Ruhr will provide new possibilities with German-originated multinational companies that have activities in the Metropolitan Area of São Paulo, especially the cities of Santo André, São Bernardo do Campo (cities where UFABC has campuses), and São Caetano do Sul.

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**POLICIES**

**Policy for selection of foreign partners, considering that 70% (at least) of the resources should be earmarked for partnerships with institutions based on countries that Capes maintains effective cooperation (listed in Annex I of the call).**

The policies for choosing partners for Capes-Print are divided into two main fronts. The first is the consolidation of already established partnerships. UFABC currently has partnerships with countries with which Capes maintains effective cooperation. Interactions that have already resulted in academic products (especially high-impact scientific papers) will be prioritized, as well as the international exchange of graduate students. In this way, the Universitätsallianz Ruhr, which gathers three German universities – Ruhr-Universität Bochum, Universität Duisburg-Essen and Technische Universität Dortmund – is a partner that has already been developing collaborations with the faculty of UFABC, especially in the following fields: Engineering, Territorial Planning, Biochemistry, Chemistry, Particle Physics, and Informatics. Also in Germany, there are ongoing partnerships with Universität Münster in Computational Sciences and Biodiversity. UFABC has researchers who collaborate in multinational initiatives, such as the European Organization for Nuclear Research (CERN). Also, UFABC professors have partnerships for research and human-resources development in different universities of the United States, like Georgia Institute of Technology and North Carolina State University. The second front will take the collaborations agreed for this Capes-Print public notice into consideration thought contacts made by the coordinators of the participant Graduate Programs. These foreign partnerships are established specifically for the carrying out of qualification missions, visits of Ph.D. students, and sandwich doctorate periods. In both fronts, a list of potential foreign collaborators is headed by institutions in the United States and Europe – notably Germany, but also including the United Kingdom, France, Portugal, Spain, and Italy. Priority international partnerships will have to consider opportunities for attracting qualified students to UFABC from Graduate Programs abroad that are related to the priority themes here proposed. Besides, we must seek more mobility among administrative staff and the faculty, with the development of conjoined activities of innovation and investigation, the possibility of double degrees, qualification and virtual collaboration. Selected partnerships will have to consider long and medium-term actions and interests that will exceed the period stipulated in this institutional project.

**Grant policy and internal selection process for specific actions, within the funding lines of the Capes-Print program. In the case of cooperation projects with foreign institutions, the proposer should specify the application of funds, the plan of activities, reciprocal funding, academic mobility, technical - scientific production, counterparts in the partner institutions, among others.**



The internal selection of actions and beneficiaries will be carried out using public notices that will be published by the Office of Graduate Studies and widely publicized within the academic community using institutional e-mails, and UFABC and Graduate Programs' websites. The public notices will display the submission schedule, resources prognosis, and assessment criteria. The selection of actions will be consonant with UFABC's Institutional Plan of Internationalization and the criteria listed by CAPES and other funding agencies regarding internationalization. The selection must consider: - Project's coherence, considering justification, objectives and goals, methodology and proposed activities; - Research projects' insertion in areas that already have consolidated international partnerships and identified internationalization potential; - Priority for partnerships with institutions from countries with which CAPES maintains effective cooperation; - Excellency of the research team: researcher's qualifications, adequacy of team members for the project's goals and activities, scientific productions, mentoring of students; - The proposition of projects made in collaboration by researchers registered in different Graduate Programs, sharing activities and resources, as well as the relevance of the impact of the proposed plan of work on its area of knowledge; - The stimulus for cooperation agreements that take mutual financing of actions into account, exemption of school fees, and cotutelle agreements; and - Expected results after the carrying out of the plan of work and research project. Proposals approved by the Office of Graduate Studies will be coordinated by the faculty of the Graduate Programs, who will be responsible for the submission of the activities plan, resource application plan, proof of financial contribution of foreign partner institutions, students and researchers mobility forecast, and conjoined technical-scientific production forecast. Selected projects must intimately interact with the internationalization themes prioritized UFABC: (1) Biosystems and Biotechnology Tools; (2) Advances in Nanosciences, Structure of Matter, Quantum Physics and Advanced Materials; (3) Biodiversity, Climate Change and Science Education; (4) Challenges of sustainability for the 21st century: energy, technology, development and fight against inequality; and (5) Information and Communication Technologies, Complex Systems and Smart Applications.

#### **Policy for hiring faculty with recognized scientific performance at an international level.**

Policy for hiring faculty with recognized scientific performance at an international level. UFABC stimulates the participation of foreign professors in all of its hiring public notices, may they be for positions of assistant/associate/full professor or positions of visiting professor. The public notices are made available in Portuguese and English. In all stages, evaluation tests can be performed in both languages. Another facilitator is the diploma validation of foreign professors hired, which is made by UFABC itself. The success of this policy can be measured by the number of foreign professors among the faculty of UFABC: currently, 82 of the 689 tenured professors are foreign. The institution also has a staff of 54 visiting professors, of whom 14 are foreign. Notably, 100% of professors at the institution have a Ph.D. UFABC's Institutional Plan of Internationalization stipulates the creation of a program for visiting researchers and professors which aims at facilitating and stimulating the attraction of foreign partners that are avowedly competent in their field of

research. As stated by a Resolution of UFABC's Council for Teaching, Research and Outreach, UFABC can hire visiting professors who have a Ph.D. or equivalent, which are qualified to develop activities that will respond to specific programs of teaching, research, and outreach. The visiting professor can be of Brazilian or foreign nationality, and their service will have a fixed duration, in accordance to the Law, using a simplified selection process which must be widely publicized, including Brazil's Official Journal of the Union. Public notices are made available in English at UFABC's website, as well as publicized in websites like Nature, FAPESP, and ResearchGate. The professional who is hired as a visiting professor must have achieved a Ph.D. at least two years before the selection process, be a renowned professor or researcher in their field, and have a consistent scientific production in the last five years. The hiring of a foreign professional is conditioned to the authorization of the Brazilian Ministry of Labor and Employment and the granting of a visa by the Brazilian Ministry of Foreign Affairs. The hiring contract duration is of 24 months, and it can be renewed for up to another 24 months. With the expansion of internationalization activities at UFABC, besides the qualification of staff in foreign languages, the implementation of accommodations linked to the institution is also envisaged, to be used by visitors and collaborators who come to UFABC to perform in the actions of the Institutional Plan of Internationalization.

**Policy to increase proficiency in foreign languages for students, postgraduate faculty and technical staff that have a direct relationship with the proposed Internationalization Project.**

UFABC's Institutional Plan of Internationalization envisages the qualification of the academic community in foreign languages (priority to English) and Portuguese for those who are not Brazilian. UFABC has a Language Division that is linked to the International Affairs Office. The Institutional Plan envisages the implementation of a Language Center, with specific physical space and the support of administrative collaborators. The Center is to be responsible for providing different language courses and for consolidating UFABC's linguistic policy. The International Affairs Office keeps a database of the level of proficiency in English of the faculty of UFABC, whose input is acquired from the results of leveling tests administered by the Language Division, from the completion of modules of the Classroom English Language Course, and from the results of the standardized proficiency tests of English as a foreign language (TOEFL, IELTS, Cambridge examinations - FCE, CAE, CPE etc.). The Classroom English Language Course aims to provide language courses for UFABC's students and staff. It has a direct connection to UFABC's internationalization actions, for it seeks to include students and staff in enhancing their workability and autonomy in different languages in many situations. In addition to English, there is planning for actions in French, Spanish and Italian languages. For this purpose, public notices are annually published for hiring visiting professors to operate in the language courses. Since 2015, the courses created and offered were: English, Spanish, Italian, French, and Portuguese for non-Brazilians. Scholarships are also offered for members of the academic community, as well as the outside community, according to their skills (measured in a public selection process). Periodically, UFABC offers courses of Writing Skills for Researchers, in collaboration with

the British Council. The demand for this course has been high, and an increase in the offer of this course is envisaged within the Capes-Print scope. Furthermore, the Language Division offers leveling tests in English and Spanish for graduate students on demand of the respective course's coordination. With the implementation of the Language Center, UFABC's linguistic policy will be encouraged with definitions of strategies and approaches on the types of language courses; the linguistic preparation of students, faculty, and administrative staff widening the actions performed by the Language Division.

#### **Policy for recognition of academic and scientific activities performed by faculty and students abroad.**

On the undergraduate level, the equivalence of subjects taken in academic mobility can request at the International Affairs Office upon presentation of the necessary documents and forms. The Office of Undergraduate Studies registers the equivalence and recognition of credits in the Academic Record upon presentation of documents issued by the foreign institution. National and International Academic Mobility Programs reach students enrolled in undergraduate programs of Higher Education Institutions that have completed the curricular components of the 1st academic year, and for regular UFABC students who have been approved in, at least, 28 credits in courses of the Interdisciplinary Bachelors. Participation in National and International Academic Mobility Programs is limited to a period of two (2) academic years. On the graduate level, the use of previous credits obtained in other institutions, Brazilian or foreign, is governed by the Office of Graduate Studies. The credits are recognized upon the evaluation of the Graduate Programs coordination. UFABC also stimulates cotutelle actions. There are currently four ongoing international cotutelle agreements (with France and Spain). The preparation of the doctoral thesis is supervised conjointly and is subject to only one public defense. It is a goal for UFABC to have its faculty periodically taking part in postdoctoral research. The policy for stimulating this type of research, standardized by a Resolution of the University Council, aims at increasing the faculty international experience and to facilitate their academic updating and development, their concentration in research activities for an extended period and their collaboration with international research and outreach groups. We hope that the postdoctoral research activities will generate results that will contribute to UFABC's international insertion. The process of permission for post-doctoral periods is conducted in strict consideration to the norms and specific procedures of each UFABC Center. The professor will be released from fulfilling their pedagogic obligations, as well as other responsibilities for the post-doctoral period, without a need for previous or future compensation. Additionally, the academic activities held abroad, like participation in courses or congresses, are counted for career progressions and promotions.

**Policy for hosting and support of foreign faculty, researchers and students.**

For graduate students, International Academic Mobility is the educational modality in which any regular graduate student enrolled in a foreign higher education institution visits UFABC for a fixed period (from one month to one year, according to the activities to be developed). During this period, the student can access the campuses, borrow library books, and pay a smaller fee on the University Restaurant. The mobility student must have a co-advisor linked to a UFABC Graduate Program. The student's arrival and stay must be authorized by the Program coordination, and their focus should be in collaborating in research activities. UFABC also has two support programs for foreign and Brazilian researchers: Collaborator Ph.D. Researcher and Collaborator Researcher. The first is indicated for those who already possess a Ph.D. title or who have completed postdoctoral studies. The later is recommended for collaborator researchers who intend to use UFABC's structure to improve and develop their scientific research. Besides, UFABC can validate undergraduate and graduate diplomas obtained in foreign universities. The International Affairs Office offers the following services for welcoming foreigners: - Issuing of acceptance letters and provision of information on the necessary documents for visa application and enrollment at UFABC; - Provision of a list of places where they can find housing, such as student residences, hotels, apartment hotels, room rental, and real estate agencies; - After the foreigner's arrival, we provide counseling as to legitimation with the Brazilian Federal Police, issuing of CPF (identification number), account opening, request for transportation cards and presentation of the campuses structure; - Assignment of a "mate" for each foreign student: this program was created by the International Affairs Office to introduce the foreign student to a UFABC undergraduate student that can help them in academic, cultural and social matters. - After the study/research period, issuing of the necessary documents for credit recognition in English, certification of research, enrolment, etc., so that they can return to their country with all the necessary documents.

**Policy for the appropriation of knowledge and experience acquired abroad by the beneficiaries of the actions of the Institutional Internationalization Project.**

Appropriation of knowledge and experience acquired by the beneficiary of International Institutional Project actions while abroad will ensue from different actions, some of which are envisaged in UFABC's Institutional Plan of Internationalization, like the conduction of the International Week, an event in which professionals (students, faculty, and administrative staff) will be able to share the experiences they acquired with foreign collaborators and update the community in international themes of various research areas, as well as stimulate the propagation of science produced in international collaboration for the whole UFABC. For the conduction of such events, we intend to define themes, prospect funding sources, invite international speakers, partner universities, and internal and external community members. International Weeks will have a specific website in which the results of investigations made in international partnerships will be publicized, with links to papers published in peer-reviewed journals (and other productions). Additionally, beneficiaries of

resources must deliver reports of their activities abroad. We intend to create an online portal hosted on UFABC's domain which will store all information about approved projects, actions and the results arising from Internationalization. This will ensure the historical registry of Internationalization actions as well as guarantee the transparency of the results obtained. Initiatives promoting the knowledge and experience gathered abroad will be organized by the Office of Graduate Studies together with the Office of Research, the Office of Outreach and Culture and the Communication Advisory, which is linked to UFABC's President Office (in this case, the actions will focus on non-specialized audiences, with the goal of making the scientific-academic knowledge resulting from the Internationalization project more accessible and popular).

#### **Policy for management and operationalization of the Institutional Internationalization Project.**

Different sectors of UFABC will be involved in the management and implementation of the Project, notably the Office of Graduate Studies, the International Affairs Office, the Office of Research, and the President's Office. The Budget and Finances Coordination at the Office of Graduate Studies will follow financial assistance application processes for missions abroad and for international travels of Graduate students and the faculty who participate in the institutional project. Also, the Office of Graduate Studies will be responsible for accompanying the project's budget elaboration and execution, as well as planning, organizing, controlling and coordinating the activities related to budget, finance and accounting control, providing assistance to the Management Committee and supporting in technical-administrative and people management matters. The Budget and Finances Coordination policy will strive for maximizing efforts and resources towards the Institutional Internationalization Project's goals. The Office of Graduate Studies will be responsible for requesting funds for the payment of tickets and per diem expenses for members of the Management Committee, should the occasion arise, as well as arranging the necessary structure for Committee meetings, making internal and external contacts, elaborating official documents and other specialized texts, organizing files and documents and sorting mail according to its importance and complexity. For that end, a specific email address will be created for actions related to Capes-PrInt: [print.propg@ufabc.edu.br](mailto:print.propg@ufabc.edu.br). Graduate Programs Coordination and administrative staff assisting each Graduate Program, together with the Academic Coordination, will assist the Managing Committee in the elaboration of public notices for the proposals contemplated by the Institutional Internationalization Project, always under the supervision of the University's Juridical Procuracy. The International Affairs Office will provide support in the elaboration of the international collaboration instruments resulting from the approved projects, collaboration agreements, accords, memoranda of understanding and similar instruments. The Office of Research will be responsible for the accreditation of foreign researchers on support programs for Brazilian or foreign researchers such as: Collaborator Ph.D. Researcher and Collaborator Researcher. The policy for promoting actions, beneficiaries and results obtained will be of conjoined responsibility of the Office of Graduate Studies, the Office of Research, and the Communication Advisory, which is linked to UFABC President's Office.

**Policy for monitoring and internal evaluation of the goals of the Institutional Internationalization Project.**

The institutional evaluation process will happen in two different moments: a self-evaluation process analyzing the results of actions in the scope of the Institutional Internationalization Project, and an external evaluation process. For this project, an annual evaluation process will take place, so that we can verify the progress of activities and the fulfillment of the intended goals, as well as promote the obtained results to internal and external members of the community. The main final production indicators will be the number of cooperation agreements reached; number of cotutelle theses defended; number of UFABC representatives (faculty, students and administrative staff) in each area/sectors in foreign countries; number and variety of representatives of foreign countries hosted in area/sectors UFABC; number of scientific papers published in high-impact journals, registered patents and software involving international partners, as well as complete papers and abstracts presented in international congresses and organization of events in collaboration with international partners. The annual results of the evaluation of internationalization actions will be part of a database that will be widely publicized to the community at the UFABC's portal. The data will also be used as an input for future efforts in internationalization, as well as for aligning society and higher education system's expectations concerning the knowledge construction rooted in Interdisciplinarity, excellence, and social inclusion, which are part of UFABC's institutional mission. The evaluation of the Institutional Internationalization Project will also have the participation of UFABC's Internal Audit, whose aim is to help the University to reach its goals through a systematic assessment approach and the proposal of improvements in the internal processes, risk management, control and corporate governance, so that resources can be used effectively and efficiently. UFABC's Internal Audit's work aims at the assessment of control bodies, adding value to the actions implemented by the managing instances, as well as serving as a consulting agency on related subjects.

**Policy for the conciliation of national development programs supported by Capes to the internationalization effort.**

UFABC has participated in many initiatives to stimulate the internationalization of its community. Among those, the following stand out: PDSE, COFECUB, OEA, and PNPD. Up until the 1st quarter of 2018, UFABC has welcomed 271 foreign students of which 194 were Master's and 77 Ph.D. students. Of the total sum, about 87% come from Latin America (and 4,5% from North America and Europe). This Internationalization Project aims to expand participation in North America, Europe, and Asia (without excluding other continents) in research collaborations. In addition to participating in CAPES' PDSE program, UFABC is affiliated to FAUBAI (Brazilian Association for International Education), which promotes UFABC's potential to



international funding agencies, diplomatic representations, organisms, and programs. In the scope of FAUBAI, we have participated in international events, such as NAFSA (National Association of Foreign Student Advisers, USA) and EAIE (European Association for International Education), in which the many contacts made have facilitated the establishment of cooperation agreements and international exchanges. Furthermore, meetings promoted by CGUB (Brazilian Universities Coimbra Group) and by Brazilian Embassies in different countries stimulate the interaction between the University and local institutions. UFABC also offers scholarships for foreign students associated with the Partnerships Program for Education and Training (PAEC OEA-GCUB). PAEC OEA-GCUB is the result of the cooperation agreement established in 2011 between the Brazilian Universities Coimbra Group and the Organization of American States (OAS) and has the support of the Division of Educational Matters of Brazil's Ministry of Foreign Affairs (DCE/MRE) and the World Health Organization's Pan American Health Organization (PAHO/WHO). The Program is intended for citizens of the 34 member States, except Brazil. Currently, we have 14 regular students, 5 students to start studying in this year's second quarter and 13 students who have completed their studies. We also participate in CNPq's Program for Partner Graduate Students, which selects students from developing countries with which Brazil maintains Educational, Cultural, or Scientific and Technological cooperation agreements for doing their graduate studies in Brazil, in all areas of knowledge, at a Master's or Ph.D. level. All activities will be integrated with the actions envisaged in Capes-Print.

**Describe here other innovative policies that will be adopted by the institution that were not addressed in the above items.**

1) Student mobility between different Graduate Programs: The need to break disciplinary barriers is central in UFABC's academic-administrative structure. Distinct from traditional universities, UFABC has no departments, but three large multidisciplinary Centers: the Center for Natural and Human Sciences (CCNH), the Center for Mathematics, Computation, and Cognition (CMCC), and the Center for Engineering, Modeling and Applied Social Sciences (CECS). Thus, the Graduate Programs answer directly to the Office of Graduate Studies, so the professors' registering to a specific Graduate Program depends only on their academic-scientific profile's affinity to the Programs, regardless of the Center to which they have been allocated. This structural arrangement makes it easier for graduate students to take courses of different programs, which stimulates the development of interdisciplinary research projects and the expansion and complementation of the students' academic formation. Interdisciplinarity, which guides all UFABC's policies, enables integrative propositions, stemming from perspectives, for the solution of complex problems in both micro and macrocosm. 2) Strategic Research Units: since 2008, UFABC has officialized the so-called "Strategic Units", whose goal is to stimulate the production and promotion of knowledge in strategic and innovative areas of the University, bolstering interdisciplinarity, a fundamental characteristic of the Institution's Pedagogical Project. The premise of innovation in scientific activities is part of the actions envisaged in the Brazilian Ministry of Science, Technology, Innovation and Communication plan. In fact, considering what is proposed on the National Strategy in Science, Technology and Innovation for the period

of 2016-2019, innovation should have a part in all of Brazil's strategic topics (water, food, energy, society and digital economy, health, bioeconomy, spatial, nuclear, and converging and enabling technologies). The Strategic Units' main activity is scientific and technological research associated with the transmission of knowledge and interacting with undergraduate and graduate courses, as well as outreach activities. The activities developed by the Strategic Units must ensure the innovative character of the projects by seeking interdisciplinary integration and cooperation with the different multidisciplinary Centers and other instances in the University. In that way, the Strategic Units must gather Brazilian and foreign faculty and students to elaborate research projects, and to promote scientific events and outreach actions associated with their specific field of work. The Strategic Units keep a constant dialogue between their thematic areas with the university community, as well as the regional, national, and international communities. Therefore, actions promoted by the Strategic Units have direct interaction with UFABC's internationalization efforts, stimulating projects, and researchers' international exchanges.

3) Academic Industrial Ph.D.: Academic Industrial Ph.D. is a modality of admission to existing Ph.D. courses in which the Ph.D. project is a result of a period the student experienced in labs and research centers of public and private companies. After the elaboration and the approval of the developed project in this initial stage (pre-Ph.D.), the students will be regularly enrolled in a previously selected UFABC Graduate Program. After the completion of the Ph.D., the diploma issued for the Academic Industrial Ph.D. student is identical to those issued for students admitted in regular selection processes of UFABC Graduate Programs. This initiative was funded by the celebration of and cooperation agreement between CNPq and UFABC in 2013. In the last year, the Academic Industrial Ph.D. had 26 Ph.D. students, of which 20 had scholarships. Companies registered to the Program present challenges in various areas: development of polymeric materials for application in high temperature and pressure, development of special systems for the transportation of materials, recycling of industrial generated materials, nanotechnology applied to the reduction of metal alloys abrasion, among others. Among the 29 companies registered to the Academic Industrial Ph.D., there are small, medium-sized, and large companies, including multinationals. In this segment, discussions have been channeled to the development of a project which involves industrial units abroad, in such way that the students can perform their research both inside and outside Brazil. UFABC and CNPq are currently implementing the Entrepreneurial-Academic Master's, which follows Academic Industrial Ph.D.'s premises. In addition to projects in collaboration with the industrial sector, the Entrepreneurial-Academic Master's will allow the establishment of partnerships between graduate programs and sectors such as start-ups, logistics, and technology companies, hospitals, among others.



## **FURTHER INFORMATION**

**Number of postgraduate courses taught in English between 2013 and 2016.**

**Quantity of courses:** 40

**Number of joint supervision postgraduate programs between 2013 and 2016.**

**Quantity of programs:** 1

**Number of double degree postgraduate programs between 2013 and 2016.**

**Quantity of programs:** 0

**Number of bilateral postgraduate programs between 2013 and 2016.**

**Quantity of programs:** 0

**Number of products derived from research projects and contributions to international databases between 2013 and 2016.**

**Quantity of products and contributions:** 1734

**Number of Capes' development programs from which the institution benefited between 2013 and 2016.**

**Quantity of programs:** 9

**Number of Capes' international cooperation projects from which the institution benefited between 2013 and 2016.**

**Quantity of projects:** 17

**Insertion of materials, themes and subjects in foreign language in the postgraduate program curricular structure.**

**Description** – There are several strategies involving Graduate Programs in the Institutional Plan of Internationalization of UFABC. Concerns the insertion of Foreign Languages materials, themes, and subjects, we expect the following for the five-year period of 2018-2023: - Strategy 1. Increasing the number of language courses offered for the university community, raising the number of students, course levels, and languages offered, prioritizing English. Expected Results: a comprehensive offer of different language courses, prioritizing English, for a large number of UFABC undergraduate and graduate students; - Strategy 2. Establishing an annual offer of subjects taught in English in both undergraduate and graduate programs, as to make possible for foreign students who do not speak Portuguese to study at UFABC. Expected Results: The offer of subjects in English in both undergraduate and graduate programs; attraction of foreign students; qualification of UFABC students for the international academic environment; opportunities of acquisition of technical English vocabulary in the several areas of knowledge; creation of an international and intercultural environment inside UFABC campuses; - Strategy 3. Offering qualification courses for the faculty to teach in English. Expected Results: The increase of the number of subjects taught in English in

both undergraduate and graduate programs; increase of academic production in English; - Strategy 4. Creating curricula integration experiences with foreign country programs, including double-degree. Expected Results: Promoting the collaboration and integration between UFABC and the international academic community; - Strategy 5. Stimulating the establishment of undergraduate and graduate double-degree agreements, including cotutelle Ph.D. Expected Results: Broadening and further developing UFABC's undergraduate courses and graduate programs' relations with international partners.

## PROJECTS

## THEME 1

## BIOSYSTEMS AND BIOTECHNOLOGICAL TOOLS

## INTERNATIONAL COOPERATION PROJECTS

Name of the project	Start date	End date
Study of cellular and molecular mechanisms involved in the progression and treatment of pathologies of Public Health interest	01/01/2019	31/07/2022

## Description

The study of different pathologies involves different lines of scientific investigation such as Biochemistry, Physiology and Cell Biology. The most remarkable research topics are Cancer, and Cardiovascular, Dermatological and Viral Diseases. The studies of the pathophysiological mechanisms on cellular and systemic levels aim to establish relationships between molecular characteristics and changes on biological functions, dynamics and interactions among biological components and the environment in the different studied models (prokaryotes and eukaryotes), characterizing the general aim of this proposal. Specifically, it is important to highlight: a) the study and production of new generations of immunotherapy with high antitumor potential, in order to understand T-lymphocyte exhaustion mechanisms mediated by extracellular matrix molecules, and to enhance immune system for cancer treatment; b) the study of cell death mechanisms in tumour cells, involving the mitochondrial-endoplasmic reticulum axis and the role of Bcl-2 proteins in those processes, to develop new targets and drugs for antitumor chemotherapy; c) the characterization of intracellular calcium control proteins and the study of mitochondrial dysfunctions in cardiac tissue; d) the characterization of cutaneous microbiota and the analysis of the immune response in patients with seborrhoea dermatitis; and e) the study of molecular mechanisms related to the presence of cytomegalovirus and tumour progression/oncomodulatory potential.

Name of the project	Start date	End date
Bioactive compounds and their technological applications in biological systems	01/11/2018	31/07/2022

## Description

Chemical transformation processes are linked to functional and structural changes of substances and materials. This research area is defined by the recognition, characterization, interpretation, and analysis of these processes. Mainly, the current project focuses on the structure and function of bioactive compounds and their application in transformation processes occurring in biological systems. Bioactive compounds will be studied within three major work lines: (a) nanoparticles, (b) natural products derivatives and (c) synthetic organic substances - (b) and (c) are highly overlapping. Experimental parameters that lead to the control of the morphology and crystalline structure of inorganic nanoparticulate systems will be investigated, using solvothermal synthesis assisted by microwaves. Metallic nanoparticles will also be prepared using biogenic routes, with interest on their biomedical and environmental applications, highlighting the specific relevance of systems that act as nitric oxide donors. These, when used as a way of enhancing subcutaneous storage of nitric oxide, show a remarked potential for dermatological application. The isolation and structural characterization of biomolecules with antiparasitic action is connected to the obtainment of natural bioactive compounds using counter-current chromatography coupled to mass spectrometry. Also, bioactive substances based on natural products will be prepared and studied, exploring the use of compounds' libraries defined by structure/activity relationships. As a way of keeping up with the need on finding treatments for neglected diseases, focusing on malaria, leishmaniasis, dengue, Zika, and bacteria resistant to antibiotics, this research proposal also aims to implement methodologies for the synthesis of bioactive organic substances and their biological evaluation in models of these pathologies. The use of cyclic organic peroxides (dioxetanes and trioxolanes) and antimicrobial peptides as therapeutic alternatives against pathogenic organisms will be evaluated. Bioactive molecules will also be synthesized through multicomponent reactions, with or without metalloids-based functional groups (selenium and tellurium), or by traditional sequential transformations, using batch or continuous flow methodologies.

Name of the project	Start date	End date
Development and Characterization of High Value Biotechnological Products	01/11/2018	31/07/2022

**Description**

The study and characterization of biological systems in strategic areas such as Biophysics, Biochemistry, Molecular and Genomic Biology are fundamental for the production of high-value biomolecules, such as biopharmaceuticals, precursors for chemical synthesis and biofuels. The collaborations currently established by UFABC and its international partners converge to those issues. The present research proposal aims to aggregate lines of work involving characterization of different types of biomolecules of biotechnological interest through several experimental approaches, as well as to improve processes involved in the production of such molecules. The specific aims of this project involve several areas, especially concerning: (i) use of biophysical techniques (such as X-Ray Diffraction, Small Angle X-Ray Scattering, Neutron Scattering, and Transmission Electron Microscopy) to characterize the interactions between new drugs and their target molecules, using structural studies involving microorganism proteins and biomimetic membrane systems; (ii) production and characterization of enzyme inhibitors produced by recombinant DNA techniques, novel peptides, antibodies and antibody fragments capable of inhibit serine proteases and other proteolytic enzymes of therapeutic interest, and (iii) characterization and using of gene expression for controlling mechanisms to produce new genetically modified microorganisms with high industrial potential for producing biofuels, biopharmaceuticals and other biomolecules of biotechnological interest.

Name of the project	Start date	End date
Development of New Drugs and New Pharmacotherapeutic Approaches for the Treatment of Human and Animal Pathologies	01/01/2019	31/07/2022

**Description**

The physicochemical and pharmacological limitations presented by commonly used drugs have directed the research for structural analogues and for new molecular targets able to function as alternative mechanisms of action, which may increase the therapeutic efficacy of those molecules. Those new approaches involve concepts related to Bioinformatics and Pharmaceutical Technology and have revolutionized several areas of Medicine. In this context, it is worth noting the studies on Molecular Modelling and Dynamics, where molecular structures are simulated, and interactions between drugs and their molecular targets are analyzed, to create new drug candidate molecules. Another important strategy described to overcome traditional biopharmaceutical approaches used in clinical practice involves using and developing new drug delivery systems or nanocarriers. Towards integrating these two aspects, this research proposal aims to design new molecules and to improve pharmacotherapeutic approaches, as well as to evaluate their application for treatment several human and veterinary pathologies. Specific aims are: (i) studies of modelling / molecular dynamics, protein-protein docking and virtual screening for the development of new allosteric inhibitors and identification of their therapeutic targets; (ii) studies of the influence of coating with proteins on the stability and conductivity of silver nanoparticles; (iii) biogenic synthesis and development of silver (nitric oxide donors) and copper nanoparticles for biomedical, environmental and agricultural applications; (iv) development and pharmacological evaluation of thermosensitive hydrogels as drug nanocarriers systems. In this research proposal participates researchers associated with the Nanomedicine Research Unit, characterizing its high potential for technological innovation.

Name of the project	Start date	End date
Biotechnology Research as a Powerful Tool for the Brazilian Health Service	01/08/2018	31/07/2022

**Description**

The area "human health in its various dimensions: from healthcare to sanitation, from food to medical technologies" is one of the priorities of scientific and technological research in Federal University of ABC, according to its Institutional Development Plan for Internationalization 2013-2023. Indeed, we consider this topic

an relevant way of connection towards international research networks and should be considered as a priority for internationalization efforts. This proposal is focused on the characterization of biological models (molecules, cells, tissues, and systems) that may foster the future development of products and processes within the framework of health services in Brazil. Scientific investigations in the field of biotechnology will be highlighted, considering both fundamental science and potential applications on the following significant areas: infectious diseases, neural and cardiovascular diseases, neglected diseases, orthopaedics, genetics and regenerative medicine and neoplasms. Investigations will be conducted into the following issues: (1) cancer treatment based on gene therapy, (2) development of biocompatible materials for prosthesis manufacturing and tissue regeneration, (3) understanding of the mechanisms involved in reproductive, metabolic and cardiovascular diseases, and (4) characterization of biomolecules for the development of vaccines, drugs and biocidal agents.

Name of the project	Start date	End date
Development of tools for the improvement of biotechnological processes applied to the medical field and agroindustry	01/11/2018	31/07/2022

#### Description

Modern biotechnology is an area that has grown dramatically in recent decades. In response to demands required by growing population growth rates and in consumption patterns changes, areas such as agriculture and medicine have become increasingly dependent on the generation and improvement of biotechnological processes. Thus, studies related to the identification and characterization of biomolecules and biological systems of commercial interest have become fundamental. However, the enhancement of this research area is still hampered due to instrumental limitations. The present project aims to find new technological solutions that allow explaining the complexity of biological systems with higher sensitivity, accuracy and in a minimally invasive manner. Such technological solutions will involve: (1) the development of tools related to the generation of nanoparticulate systems of biotechnological interest, with particular interest in the delivery of drugs and nucleic acids; (2) development of instrumentation based on the interaction of light with biological systems, especially in the generation of medical and dental equipment for diagnosis and treatment of injuries; (3) generation of genetically modified organisms with agroindustrial application, emphasizing studies involving the improvement of energy generation processes from renewable and medical resources, generation of recombinant proteins and drugs; (4) development of tools and analysis involving "omics" technologies, with interest in the characterization and selection of animals and plants of commercial interest. We expect that the research may contribute to the generation of new strategies for diagnostic and therapeutic intervention of human and veterinary dysfunctions, as well as to serve agroindustry in the generation of new technologies.

Name of the project	Start date	End date
New scientific and technological developments in biotechnology	01/11/2018	31/07/2022

#### Description

New innovation-oriented business models in the industry have risen. Until the early 1980s, there was no connection between traditional biotechnology techniques and genetic opportunities. The scientific basis of biotechnology has been developed in university and government laboratories; consequently, small science-based businesses were firstly located nearby significant universities and research institutes. The project aims to investigate how the new routes of scientific and technological development in biotechnology are being developed worldwide. We expect the following outcomes: 1) Understanding conceptual aspects involving innovation and development of emerging biotechnologies \* Examining technological development trajectories in biotechnology by evaluating patents in national and international databases. \* Analyzing the state-of-the-art market based on financial indicators produced by companies. 2) Prospective studies and emerging technologies \* Mapping the nature and interaction of scientific, technological and innovative countries such as USA, Germany, Japan, and England, which have the most significant global dynamism in biotechnology. \* Conducting a prospective study to examine future scientific and technological developments in biotechnology by analyzing information and reviewing the national and international literature on the subject, as well as examining protected technological solutions in databases patents and scientific impact publications. 3) Technology and Market Scenarios in Biotechnology \* Conducting a prospective study to examine possible future scientific and technological developments in

biotechnology by examining technology solutions in patent databases, scientific publications, technology licensing, and business market data analysis. \* Conducting an essay to measure the size and value of the biotechnology market, analyzing variables such as the potential of technology acquisition, market players and sales values of these technologies.

**THEME 2**

ADVANCES IN NANOSCIENCES, STRUCTURE OF MATTER, QUANTUM PHYSICS AND ADVANCED MATERIALS

**INTERNATIONAL COOPERATION PROJECTS**

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Synthesis, characterization and simulation of advanced materials	01/11/2018	31/07/2022

**Description**

This research project aims to strengthen the internationalization of the area of Condensed Matter Physics of UFABC, from the perspective of synthesis, characterization, and simulation of materials. This area has advanced very rapidly in recent years; one of its main characteristics is interaction with other areas, mainly Chemistry and Materials Science, focusing on the development of interdisciplinary research. This advance is addressed in this project through a collaborative process between researchers of the Graduate programs in Physics, Chemistry, and Nanosciences and Advanced Materials. This collaborative interaction, along with existing international collaborations as well as possible new collaborations, will serve as a catalyst for the development of bolder and broader projects as well as for training of the graduate students involved. The area of Condensed Matter Physics at UFABC counts on researchers specialized in the growth of materials, by physical and chemical routes, focusing on ceramic, magnetic and semiconductor materials; in the characterization of materials, through techniques such as X-ray, Rietvelt, magnetization, electrical conductivity, and magnetoresistance; and in the computational modelling of materials using classical and quantum methods. It is important to highlight the enormous importance of these collaborations for the development of new technologies and innovation in a broader context. The development of new materials gave us access to fast superconductors (semiconductors), potent lasers and more efficient drugs. The interaction with foreign research groups will allow the advance of Condensed Matter Physics studies and the training of highly qualified students at UFABC.

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Challenges of Astrophysics, Cosmology and Gravitation for the 21st Century	01/11/2018	31/07/2022

**Description**

Among the fundamental interactions, three are described by unified quantum theory, i.e., the Standard Model. The fourth and last interaction is the gravitational one, described by classical theory, General Relativity (GR). Even without a theory of quantum gravitation, we can understand much of the phenomena that occur in the Universe at large scales with just the GR. Also, the study of astrophysical objects, such as neutron stars and black holes, is done through GR. Recent direct observations of gravitational waves by the LIGO / VIRGO detectors have initiated a new era of astrophysical observations - the astronomy era by gravitational waves - which now allow testing extreme limits of GR. Therefore, theoretical analyzes and numerical simulations in GR are essential not only to model and explain observational results but also to guide and guide new experimental investigations. Due to the immense difficulty in accessing experimentally regimes where Quantum Gravitation is important, we propose semiclassical theories that extend the GR and unify Gravitation with the Standard Model. Black holes, with singularities and event horizons, constitute a theoretical laboratory in which we can explore semi-classical effects such as Hawking radiation and cosmological particle production. An experimental alternative to explore classical and semi-classical effects of gravitation is the Analog Models, i.e., non-gravitational physical systems (hydrodynamic, optical, condensed matter, etc.) that reproduce, in certain regimes, the propagation of waves in spaces-curved times. In particular, analogues of black holes may be constructed in laboratory using, for example, water. This is a recent area of research that, in addition to the study of gravitation itself, stimulates the development of technological innovations in the associated non-gravitational physical systems. On the theoretical side, unified RG and Field Theory techniques, such as AdS / CFT holography, have been used to solve problems in highly interacting physical systems ranging from matter (particles) to high energies to the physics of condensed matter. In particular, the applications of emerging AdS / CFT holography techniques allow solving problems in highly correlated systems (in material sciences) and highly interacting (in particle physics and high energies) systems whose usual techniques are difficult to apply and often fail.

Name of the project	Start date	End date
Spectroscopy, Spectrometry and Computational Simulation Applied to the Study of Biomolecules and their Interaction with the Environment	01/11/2018	31/07/2022

**Description**

Macroscopic properties of matter depend on its composition, degree of microscopic organization and the environment in which it is immersed. The study of the structure of matter allows predicting and interpreting the chemical behavior of substances along with the functionality and properties of materials. Specifically, this research project aims to study and describe the structure of biomolecules, such as proteins and biomembranes, as well as their interaction with the surrounding environment (from aqueous solvation media to metallic surfaces) and with other molecules. Electronic and structural properties will be determined through photoelectronic spectroscopy, mass spectrometry and synchrotron irradiation (VUV and X-Ray) experiments, and the acquired experimental results will be confronted with simulated data obtained from *ab initio* and DFT theoretical methods. The interaction of biomolecules with the environment and other molecules will be studied using a diverse array of strategies. The behavior of biomembranes in conditions of oxidative stress will be evaluated using computational microscopy. Employing time-resolved fluorescence methods, the influence of specific solvation effects and supramolecular assemblies formation over energy transfer processes will be evaluated, while these will also be assessed using QM/MM simulation methods. Especially, computation simulation methods will be used to describe the properties of metal/water interfaces and the behavior of molecules in such environment. Applying mean field methods to describe such interfaces, large amplitude modes in proteins will be studied, and their relationship with substrate bonding and catalytic power. Overall, one of the subjects of this proposal is related to machine learning for processes occurring at interfaces and surfaces, aiming the design of chemically relevant properties (e.g., adsorption energies and charge transfer capacities). Molecular dynamics simulation at constant chemical potential will be applied in the description of charge transfer processes concerning molecules adsorbed at metal/water interfaces. The collective use of experimental techniques and simulation methods will promote a better understanding of how biomembranes and proteins tend to interact with their environment and with chemical substances that define/regulate their properties and behavior.

Name of the project	Start date	End date
Disruptive Advances in Quantum Technology: Technological Development and Strategic Innovation for the 21st Century	01/11/2018	31/07/2022

**Description**

Quantum mechanics produced an enormous technological revolution by providing the scientific basis for microelectronics in the 20th century. We can safely say that much of the nowadays world economy depends intrinsically on the progress made in this area. Advances in miniaturization techniques, in recent years, have provided the control of individual quantum systems, consisting of a few atoms, molecules or photons. This is the scenario where the so-called quantum technologies have been developed. They exploit the fundamental principles of quantum physics and promise disruptive changes in technological paradigms. This unique historical situation has been called the second quantum revolution, in which non-classical effects (such as superposition, matter interference, entanglement, nonlocality, etc.) play a key role in achieving advantages such as efficiency and security in communication protocols (quantum communication), information processing (quantum computing) or even precision in ultra-sensitive sensors (quantum metrology) when compared to their classic (conventional) analogues. The development of quantum technologies is of vital and strategic importance for any nation. Great investments are being made, around the world, with the aim of developing and controlling these new technologies. Pioneering experiments in the area of quantum thermodynamics were performed by researchers at UFABC. These findings have been drawing the attention of the international scientific community and receiving extensive international media coverage [see the list of comments at: <https://www.quantumufabc.org/media>]. Also noteworthy is the fact that Ph.D. students supervised by members of the proponent group have twice received the CAPES Grand Prize for the best doctoral thesis in the area of Natural Sciences and Engineering (2013 and 2017). This demonstrates the rigor and scientific excellence of the research in this area made in UFABC. For the continuity of this leadership, it is fundamental the interaction with several international research groups. In this project, we intend to develop experimental and theoretical aspects related to quantum technology in the frontier of knowledge through a great international insertion.



Name of the project	Start date	End date
Fields and Particle Physics: discoveries and innovations for a new millennium	01/11/2018	31/07/2022

#### Description

This research project seeks to strengthen the internationalization of the Field Theory and Particle Physics research areas at UFABC from both experimental and theoretical perspectives. To achieve this aim, the collaborations with research groups from different countries will be tightened through overseas missions, sandwich doctorates, and the attraction of foreign researchers for internships in Brazil. The challenge behind Fields and Particle Physics is the understanding of the most fundamental constituents and forces (or interactions) of nature. Currently, three of the fundamental interactions - electromagnetic, strong and weak nuclear - are described by a unified quantum theory, the Standard Model. One of the main predictions of this model, the existence of a particle called a Higgs boson, was recently confirmed in the LHC, made at CERN with the participation of researchers from UFABC. The Standard Model, however, still fails to answer fundamental questions such as the nature of dark matter and energy, matter-antimatter asymmetry, vacuum stability, problems of hierarchies, mass and mixture of neutrinos, survival of the Lorentz symmetry on the Planck scale, the existence of additional symmetries (such as supersymmetry), as well as the incorporation of gravitation into a quantum theory, a theoretical challenge that has not yet been overcome. In the context of experimental physics, we emphasize that UFABC has participated in several of the world's leading experiments in the area. In addition to the LHC above, we can also cite: \* The Pierre Auger Observatory, the world's largest observatory dedicated to the study of ultra-high energy cosmic rays; \* The Cherenkov Telescope Array (CTA), which will be the largest array of telescopes for the study of high-energy gamma rays; \* Deep Underground Neutrino Experiment (DUNE), an experiment aimed at neutrino precision physics, under construction in the USA. It is also important to mention the enormous importance of these experiments for the development of new technologies and innovation in the broader sense. The most celebrated example of this was the development of the Internet at CERN, which has dramatically changed the world in recent decades. The enormous technical challenges faced in the development of these experiments serve to cross the frontiers of current engineering and technology, and Brazil's participation in these experiments must be seen as a unique opportunity for national development.

Name of the project	Start date	End date
Advanced Materials: Fundamental and Applied Studies	01/11/2018	31/07/2022

#### Description

The main aim of this research project is the strengthening of international collaborations related to nanoscience and nanotechnology. As an interdisciplinary area, research will be carried out involving synthesis, characterization of physical/chemical properties and computational simulation of several materials with strong scientific and technological interest. The materials to be studied - both at the nanometric and bulk scale - will be perovskites; biocomposites; topological insulators; super/semiconductor, thermoelectric and magnetic materials; self-assembled biomimetic compounds; mono-, poly- and nanocrystalline compounds and alloys; nanocomposites; ceramic, glassy and polymeric materials. We highlight the interest in the so-called "smart materials", which present electrical properties such as conductivity, electromagnetic shielding, electromechanical actuation, besides the typical properties of polymeric materials, such as flexibility and low density. The project covers a broad spectrum of technological applications related to clean energy, spintronics, storage and display of information, pharmaceuticals, electronic devices, solar and photoelectrochemical cells, biosensors, hydrogen storage, among others. The synthesized materials will be studied with experimental and theoretical tools such as X-ray techniques, vibrational spectroscopy, ultrafast spectroscopy, electron microscopy, magnetization, photonics, electrical and thermal transport; and classical and quantum computational simulation methods of materials. Intrinsically, this project will stimulate interaction between students and advisors of the groups involved through exchanges with international institutions. The issue of synthesis, characterization, and simulation of materials is interdisciplinary and acts at the interfaces between physics, chemistry, and biology. The groups with which researchers interact abroad are leaders in the proposed techniques. The specific proposals are connected to the projects approved by FAPESP and CNPq for the research productivity grants of all project members. Using local and international interactions, we will contribute to the formation of highly qualified human resources (masters and doctors), and the advancement of scientific knowledge and technological innovation.

Name of the project	Start date	End date
Advanced Materials for Structural and Functional Applications	01/11/2018	31/07/2022

**Description**

The main objective of this research project is the development of advanced materials for structural and functional applications. The targeted materials have possibilities for future industrial applications, in different time scales, allowing synergistic interaction between the academy and local and national industries. Moreover, this interaction will promote training of high-quality professionals capable of developing their careers in both public, academic institutions, and private sector, contributing to improve the competitiveness of national industries. The development of these materials is an intrinsic multidisciplinary activity. Hence, the wide range of competencies and complementary research lines of the professors of UFABC is an advantage. The project includes research on computational modelling of structures and properties of materials (DFT, molecular dynamics, Kinetic Monte Carlo approaches, and so on), conventional and advanced characterization techniques (AFM, SEM, HR-TEM, Light and X-ray spectroscopy techniques, etc.) for in-situ and ex-situ investigations, several synthesis routes (CVD, PVD, electrospinning, hydrothermal, microwave assisted techniques, etc.), investigations of processing routes (3D manufacturing, casting, sintering, severe plastic deformation, thermomechanical processing, etc.), and property measurements and performance evaluations (optical, electrical, mechanical, thermal and magnetic properties, corrosion resistance, fatigue life assessment, etc.). Industrial sectors with potential interest in the research lines encompassed in this project are automotive, aerospace, fine chemicals, metallurgy, steelmaking, semi-finished products, sensors and actuators, energy, glass products, and microelectronics. In recent years, It is noticeable the increase of the collaboration between UFABC and renowned foreign researchers from France, Canada, Germany, Sweden, England, among others. Therefore, the granting of this project will increase and strength these collaborations through the scientific interaction between Brazilian researchers and Ph.D. students with foreign partners.

**THEME 3****CHALLENGES OF SUSTAINABILITY FOR THE 21ST CENTURY: ENERGY, TECHNOLOGY, DEVELOPMENT AND FIGHT AGAINST INEQUALITY****INTERNATIONAL COOPERATION PROJECTS**

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Optimization of transformation processes aiming technological advances in analytical methodologies and preparation of nanoparticles and electrocatalysts	01/11/2018	31/07/2022

**Description**

Chemical transformation processes are connected to functional and structural changes of substances and materials. This research area is defined by the recognition, characterization, interpretation and analysis of these processes. Usually, transformation processes are dependent on the conditions they happen. Temperature, pressure, pH, and concentration variations can favour different routes and products. In this way, the determination of the ideal conditions to a specified process to happen as expected is one of the goals of this area. In the present project, we intend to investigate the synthetic parameters that lead to the control of morphology and crystalline structure of inorganic nanoparticles synthesized by microwave assisted solvothermal routes. Nanoparticles with different shapes may have different activities if used as electrocatalysts, for instance. To investigate these different activities and adsorption processes, and to determine the reaction mechanisms dependent on the superficial structure, single crystal electrodes, considered as model electrodes, will be used as electrocatalysts to study reactions with technological interests. In the case of electrochemical transformations, we also intend to study the most favourable conditions, including several kinds of catalysts, to advanced oxidation processes to the remediation of aqueous industrial wastes and to use new methodologies to investigate the localized corrosion in petroleum-water interfaces. Analytical methodologies are essential to products and intermediaries determination, and to quantitative analysis of reactive and non-reactive species. Thus, the development of analytical methodologies is also a goal of this project. We intend to study and to propose micro-decomposition and microextraction analytical procedures ideal to the determination of species of food, environmental, technological, pharmaceutical and clinical interests.

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Human Rights: from theoretical foundations to contemporary trends at the local level (cities)	01/11/2018	31/07/2022

**Description**

The central objective of this research project is analyzing theoretical fundamentals of human rights and its contemporary trends regarding the implementation at the local level (cities). In contemporary democracies, local level entities have gained notable importance in the formulation and implementation of public policies. A transversal human rights conception has ensured influence in areas such as education, health, housing and public security. In this sense, the project aims to strength interdisciplinary research in human rights based on centers of excellence in four countries (Brazil, Germany, Spain, and Portugal). Research and data from national bases as well as International Organizations have shown the growing importance of human rights policy at the local level, impacting the lives of people. The internationalization axes of the present project are: partnership with the University of Duisburg-Essen, which sent a mission to Brazil, in 2016, and will come back in 2018 - such partnership is under the general agreement (2012) between the UFABC and the Universities of the Ruhr Valley (Duisburg-Essen, Bochum, and Dortmund); partnership with the Universidad Autónoma de Barcelona, through another agreement with UFABC (2016); and partnership with the University of Coimbra (2017). The project is conceived under the University Pact for the Promotion for Respecting Diversity, Peace, and Human Rights Culture, a Ministry of Education initiative together with the Ministry of Justice, under which the UFABC acceded (2017). This Pact lists activities in different areas, including research areas backed by the 2017 Action Plan, approved by the UFABC Human Rights Committee.

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Planning and Governance for sustainable metropolitan Regions in Latin America and Europe in the context of climate changes	01/11/2018	31/07/2022

**Description**

The objective of this project is to consolidate an international and interdisciplinary research and education network aimed at generating knowledge and capacity building in the field of planning and governance of metropolitan regions in Latin America and Europe in the context of climate changes. The emphasis will be on the generation of knowledge and contributions to face the challenges connected to processes of metropolization, such as social and racial segregation, degradation of natural and environmental resources, and particularly climate changes and the proliferation of socio-environmental risks. The goals are: 1) To integrate local, national and international projects developed in UFABC and its international partners, to converge in the generation of new knowledge as well as in the search for contributions to the solutions of the challenges above; 2) To increase the international scientific production of UFABC faculty and students through joint research projects, international workshops/seminars and participation in international congresses; 3) To promote cooperation and gradual integration of graduate programs by expanding the number of courses taught in English, the international students and researchers exchange, and by the alignment of curricula for future double and multiple diplomas; 4) To stimulate processes of learning and integration with regard to academic and professional formation/capacity building, and training in the field of planning and public policies in a context of metropolization and increasing climate variability (it is worth mentioning that UFABC and the universities of Dortmund and Groningen offer integrated courses/programs in territorial planning from the undergraduate to Ph.D.).

**Name of the project**

Catalytic and electrocatalytic transformations to obtain energy and higher added value products from biofuel and oil derivatives

**Start date**

01/11/2018

**End date**

31/07/2022

**Description**

The central objective of this research project is to study transformation processes of oil derivatives and renewable natural products into higher added value substances, and to investigate the development of new alternative energy generation sources, focusing on fuel cells and biocells. Regarding sustainability, the use of renewable and inedible natural products from cultivable plants, as well as their industrial wastes, is a good option. Due to their specific properties, some natural products can be directly used with no chemical transformation. Some feedstock from biomass, however, are rich in complex molecules (fatty acids, saccharides, terpenes, phenolic compounds derived from lignin) which can be valued after selective catalytic transformations that satisfy the atomic economy criteria. Catalytic conversions are also useful in the transformation of oil derivatives into high added value products useful in chemical, pharmaceutical, cosmetic, perfume, and flavor industry. One of our goals is to study this kind of catalytic transformations. Biomass is also a renewable feedstock for biofuel production, which is useful for obtaining energy from fuel cells. Fuel cells are the most efficient way to convert chemical energy from fuel molecules into electrical energy. Specifically, we intend to study the mechanism of the electrooxidation reactions of alcohols used as fuel in fuel cells. Together with the study of reaction mechanisms, we will also investigate catalytic materials to be used in fuel cells directly working with a liquid material - the aim is to obtain, for the studied conversions, more efficient electrocatalysts for both energy obtainment and creation of higher added value products. The evaluation of the controlled release of fuels in an oil/water interface will be studied with electrochemical microscopy to analyze the processes occurring in the system interface and to understand how the migration of molecules takes place from one environment to another.

**Name of the project**

Sustainable Energy Storage and Production

**Start date**

01/11/2018

**End date**

31/07/2022

**Description**

The present proposal aims to study and develop new materials (mostly in nanometer scale) that allow the production and storage of clean and sustainable energy. It aims to investigate and develop a wide range of new materials and devices for sustainable energy generation free the most part emission of pollutant. Among them, we can exemplify materials with the potential to develop photovoltaic systems, solar cells, photo (catalysts), fuel cells with different operating temperatures, batteries, biofuels, bio-batteries, biodevices and others. Therefore, the

success of this proposal could have a positive impact on reducing dependence on fossil fuels, since the use of these new materials or technologies may provide an alternative, sustainable and clean energy, decreasing the environmental impacts and providing a higher quality of life for society. Finally, from an academic / scientific point of view, the multidisciplinary nature of the project can not only contribute to a greater understanding / development of these new materials / new technologies, but also to the formation of more qualified human resources on topics that are at the frontier of scientific knowledge and are considered as strategic themes in the government plans in developed and developing countries.

Name of the project	Start date	End date
Nanoscience for Environmental Preservation and Recovery	01/11/2018	31/07/2022

**Description**

The disposal of millions of tons of short-lived products, such as packaging and disposable plastic items, has generated a significant amount of solid wastes. It results in a wide variety of environmental and economic problems for society. Also, toxic industrial wastes are also a significant challenge to be overcome in scientific and technological terms. Many synthetic routes of chemical industries, whenever possible, should be replaced by green methods, which is the challenge of the economic viability of these processes a related concern. In this sense, science, and particularly nanoscience, has contributed both to the development of new sustainable products involving green routes and advances in methods for treatment of solid wastes and effluents. Another major challenge is the distribution of potable water, free of microorganisms and emerging contaminants, to residents of regions without access to treated water. In the present research project, researchers will focus on the development of advanced materials and new processes, involving nanoparticles (metallic, magnetic, and biopolymeric) linked to functionalized organic compounds. These nanoparticles will be associated with essential oils (oxidizing agents, among others), promoting the elimination of different contaminants, such as microorganisms or chemical compounds (heavy metals, organic, dyes, etc.). These developed materials will be intended for application in filtration systems, gels, polymer membranes, active agents in bioremediation / bioaugmentation processes and other applications with environmentally friendly characteristics. The members of the research group and its foreign collaborators have expertise in using a high diversity of advanced techniques in the preparation, characterization, and application of the systems to be studied. The project presented here is focused on environmental studies with strong interrelationship with the research areas of materials, biopolymer membranes with nanocellulose and other oxidants, photochemistry, ionizing radiation, chemistry, biology, and health. We expect the proposal will directly contribute to Brazil's technological advance and social development, and to the formation of human resources.

**THEME 4**

INFORMATION AND COMMUNICATION TECHNOLOGIES, COMPLEX SYSTEMS AND SMART APPLICATIONS

**INTERNATIONAL COOPERATION PROJECTS**

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Data Science	01/11/2018	31/07/2022

**Description**

Data science is an interdisciplinary research field that comprises scientific methods, systems, and processes used to gain insights and to understand a phenomenon of interest using data in distinct formats, i.e., structured, semi-structured, or unstructured. This research area emerged as a consequence of the advancements in information technologies (e.g., GPS, wearable equipment, and hard sensors) leading to an increase in the volume of available data, the so-called Big Data. The data processing and analysis are supported by techniques and theories from different domains like mathematics, computer science, statistics, information science, and, in particular, machine learning, pattern recognition, data mining, graph theory, and data visualization. Nevertheless, several challenges remain, from the use of existing methodologies in new domain contexts (e.g., social media analysis for weather forecasting) to the development of new approaches for dealing with existing problems (e.g., text mining using deep learning). Therefore, this project aims to establish an interdisciplinary research network of international collaboration to address some challenges in the following stages of data science cycle: 1) Pre-processing and representation, including data integration, multidimensional databases, complex networks, text and multimedia mining, interoperability of different information systems and Internet-of-things; 2) Features engineering, in order to extract the relationship among the features through the neural network and symbolic regression; 3) Creation of regression and classification models through semi and supervised learning; 4) Combinatory and numerical optimization for feature selection; 5) Model validation through the interpretability of the generated model and applications to real world scenarios; 6) Challenges associated with the use of a large amount of data, as well as the use of parallel and distributed computing for high-performance systems. These studies will be applied to political science and sentiment analysis in social networks, text and multimedia mining, educational data mining, smart cities and agriculture, urban resilience against natural disasters, scientometrics, systems biology, Neurocomputing, brain-computer interface, neuromorphic computing, aided image and video segmentation, and robotics.

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Non-linear phenomena in analysis, physics and biology	01/11/2018	31/07/2022

**Description**

The mathematical description of physical and biological phenomena is often performed through mathematical modeling involving differential equations. The more realistic a model becomes, the more likely it is to incorporate non-linear effects. An example of nonlinearity is the growth of a given population of individuals in a medium: at low time scales, the population grows at a rate proportional to the number of individuals. However, after a specific time, the number of individuals has an opposite effect on their growth, thus combining a linear effect (growth) with a non-linear one (control). Nonlinear phenomena are quite common in science and a vibrant field of research in pure and applied mathematics. It should be emphasized that the mathematical study of non-linear phenomena is not a simple task, often requiring the use of special analytical techniques or numerical and computational methods. This project aims to continue several lines of research that has been developing in the past ten years in the area of non-linear phenomena. It focuses on the following topics: 1) Mathematical aspects of integrable systems, i.e., systems that have infinite symmetries, conservation laws, recursion operators and bi-Hamiltonian formulation. Of particular interest is the investigation of: a) non-evolutionary equations or systems of the Camassa-Holm type; b) algebral-geometric properties of new evolutionary equations; c) mechanical-geometric properties of Ibragimov's conservation law theory; 2) study and modelling of biological phenomena, with special emphasis on the modelling of cancer, using numerical and computational methods for simulations, and Lie symmetries to obtain qualitative information and explicit analytical solutions; 3) study of elliptical systems on manifolds, where Lie symmetries would be the basic tool to determine the group of invariance and construction of conservation laws that would enable a qualitative analysis of the properties of the proposed solutions for the investigated problems.

<b>Name of the project</b>	<b>Start date</b>	<b>End date</b>
Development and Evaluation of Innovative Technologies to Mediate Learning	01/11/2018	31/07/2022



**Description**

The sociocultural diversity of learning environments leads to the necessity of interdisciplinary development of investigations and accessible tools that can efficiently promote the learning. One of the challenges is to evaluate the impact of the tools on apprentices, educators, educational systems, and society. In this context, this research project aims to investigate methods, techniques, processes, theoretical approaches and interaction paradigms for the education and learning mediated by technologies. Technological tools will be designed and developed to mediate education and learning, considering computational, pedagogical and cognitive aspects. Such tools will be applied and their impacts evaluated in educational contexts. The research will be conducted following theoretical bases of the Universal Design which contemplate tangible and assistive digital technologies. The Universal Design allows the use of tools without the need of adaptation by a variety of people with different characteristics, with or without physical or cognitive barriers. The trajectory of this research assumes the formation of an international network which contemplates the collaboration among UFABC graduate programs and foreign institutions. The expected results are products, technologies and theoretical guidelines for the elaboration and evaluation of tools and their users. Examples of these results include tangible and digital learning objects, virtual and augmented reality environments, digital games, tools for supporting authorship of contents, and software development processes.

**Name of the project**

Combinatorics and applications in Bioinformatics, Scientometrics, and Computer Graphics

**Start date**

01/11/2018

**End date**

31/07/2022

**Description**

Computer Science is increasingly present in many fields of knowledge, fostering the need to create new technologies to deal with complex problems in different areas of scientific research. Such technological advances are possible through theoretical results that support the generation of computational models adapted to new interdisciplinary problems. For example, the study of combinatorial structures has a fundamental role in the development of efficient algorithms to solve problems in Bioinformatics, Scientometry, and Computer Graphics. In particular, analysis of complex networks, which are graphs with non-trivial topological characteristics that occur in many real-world situations, is a research area with several uses and public interest, from social behavior in networks to biological functioning of neuronal networks, genes, and proteins. This research project has two main goals: 1) to investigate structural, combinatorial, and algorithmic properties of graphs and related discrete structures; 2) to apply combinatorial techniques to obtain advances in Bioinformatics, Scientometry, and Interactive Segmentation of Images and Videos. In Bioinformatics, the focus will be on inference, modeling, and simulation of molecular biology networks, using analysis of complex networks, including the development of methods for detecting communities and repeating local structural patterns usually associated with important functions in the network. In Scientometrics, the focus is on the application of concepts of graph theory and complex networks for the analysis of academic research networks, which also involves community search, local structural patterns in graphs, and prediction of future connections. Finally, in Computer Graphics the objective is to segment images and videos through the application of Laplacian graphs built from the inputs to the problem of segmentation or co-segmentation. Although the focus of applications is mainly on the three fronts mentioned above, practically all areas of science depend on combinatorial analysis, most notably: physics, chemistry, biology, engineering, astronomy, and social sciences (especially social network analysis).

**Name of the project**

Optical Networks for the Future Internet and Advanced Applications

**Start date**

01/11/2018

**End date**

31/07/2022

**Description**

Internet traffic has grown at the rate of about 100% a year since it was first measured, dominating the communication networks since the turn of the century. The networks had been prepared for this critical moment with the deployment of a large optical infrastructure, initially over-dimensioned. The advent of the WDM technology started a drive towards bandwidth exploiting, which is now reaching the effective occupation of the optical amplifiers gain bandwidth. As the available bandwidth is limited and client demands keep growing, the elastic optical networks emerge as the first step to avoid the capacity crunch through enhancement of the network spectral efficiency. Then, two basic strategies are used: (1) distance adaptiveness, choosing the most spectrally

efficient modulation scheme concerning spectrum utilization that can provide the required noise immunity; and (2) flexibility in the allocation of spectrum resources to the user to avoid waste. A second step will deploy new fibers with several spatial modes, such that each mode may be modulated independently. However, to face the energy bottleneck, it will be necessary to limit the traffic itself through the adoption of appropriate protocols in the higher layers, eliminating unnecessary or redundant traffic through datacentric addressing. Furthermore, new technologies should be used in the access network to enhance the number of end users. In this context, we intend to study these new strategies through computational simulation and testbeds to experimental validation - the research will be improved and enhanced by the consolidation of existing international cooperation. As specific goals we want to study, develop and propose: (1) new algorithms and policies to assignment of spectral resources and routing in optical networks; (2) network survivability schemes appropriate to spectral assignment in flexible environments; (3) efficient solutions to migration of the wavelength routed networks to flexible networks (hybrid networks); (4) architectural solutions to automatic management and cloud computing over flexible networks; and (5) proper networking solutions to access networks through spatial modes multiplexing (SDM).

Name of the project	Start date	End date
IoT-based Applications for Smart Cities and Smart Farming	01/11/2018	31/07/2022

#### Description

The Internet of Things (IoT) allows people and objects to be connected at any time, from anywhere, using standard networks and protocols to access innovative smart services. Sensors of different natures in urban and farming spaces coupled with ubiquitous GPS-equipped smartphones, in addition to the resources available in the cloud, allow the automation of cities and farms to improve people's quality of life and build smarter societies. The use of a variety of combined technologies - such as IoT, cloud computing, big data analytics (e.g., machine learning techniques) and network softwarization - make it possible to build a myriad of new smart applications to the benefit of our society. Cities are becoming smarter as new and existing technologies are being increasingly used for the development of a substantial variety of services and applications for citizens and governments. Smart Cities involve not only technologies but also people and government working together to match infrastructure investments with human and social capital, which allow citizens to have a key role in the governance processes. On the other hand, in farms, the use of technology to add intelligence to the agriculture and livestock activities still has a considerable potential to generate significant advances. Precision farming, also known as Farming or Agriculture 4.0, depends on innovative technologies to increase the productivity of crops and animal products, to make efficient use of precious resources like water, and to decrease the number of chemical substances used (e.g., medicine and pesticides). The central objective of this research project is to investigate the use of IoT and related technologies in the development of innovative applications for smart cities and smart farming. As specific objectives, the proposal aims to study, specification, development, and test of: 1) IoT-based technologies, protocols, services and platforms for smart applications such as Smart Cities and Smart Farming; 2) Data storage and processing technologies combining both cloud and fog computing; 3) Concepts and technologies related to the network softwarization paradigm; 4) Smart algorithms, techniques and approaches for knowledge generation and decision-making from the gigantic amount of data generated by IoT-based applications; and 5) Techniques and approaches for the development of distributed systems and data modelling of IoT-based smart applications.



**COUNTERPART****Internationalization of the curriculum - Incorporation of international themes in postgraduate classes.**

One of the goals of the Institutional Plan of Internationalization of UFABC, approved by the University Council for the next five years (2018-2023), is to “Internationalize the curriculum”. We intend to extend the number of language courses to the academic community, increasing the number of students, levels, and variety of languages (English as a top priority). To increase the offer of different language courses for a more significant number of undergraduate and graduate students, we expect to offer the necessary infrastructure, to develop UFABC's language policy, and to promote courses offered in international collaboration (e.g., COIL – Collaborative Online International Learning). Another strategy present in the Institutional Plan is to establish an annual offer of undergraduate and graduate courses in English to allow non-native Portuguese speaker students to study at UFABC. As results, we expect: to increase the offer of disciplines taught in English at undergraduate and graduate level; to attract more foreign students; to train UFABC students in an international academic environment; to offer opportunities to improve technical vocabulary in English in different fields of knowledge; and to create an international and intercultural environment at UFABC campuses. There is still another strategy in this theme: Offer training courses for the faculty of UFABC to improve its skills in teaching in English. The institution will verify the need for training courses among the faculty and develop the contents and classes to be offered. The fourth strategy for internationalization of the curriculum is related to student mobility: to create new courses, and to translate and adapt to foreign languages existing courses. We expect to increase the number of foreign students and to promote, among the students, a global vision based on internationalization. One of the actions that will perform in this regard is to translate the courses' content of the undergraduate and Graduate Programs offered at UFABC (prioritizing English).

**Production of international publicity material in other languages, including course websites.**

The Institutional Plan of Internationalization of UFABC, approved by the University Council for the next five years (2018-2023), has a primary goal: to transform UFABC into an international reference. In this sense, a set of strategies and institutional actions will be considered. To make possible the institutional representation in higher education international events in Brazil and abroad (and to promote UFABC to potential international partners), we plan to: organize promotion stands; to update the English version of the promotion material of UFABC and to identify areas [within the university] interested in developing new ones; to offer UFABC's promotion material to institutional presentation in congress and seminars abroad. Another strategy listed in the Plan is to develop and maintain English websites and flyers to attract international partners. Concerning information about UFABC in English focusing on the attraction of partners, faculty and students from abroad, the following actions are planned: to broaden the range of information in English available on UFABC's website; to constantly update institutional websites and flyers; to contact the Graduate Programs that do not have yet an English version website (encouraging them to make their information available in English through a template page to be implemented in 2018 through the Integrated Management System for Academic Activities of UFABC).

**Training and qualification of staff for institutional internationalization.**

The Institutional Plan of Internationalization of UFABC has as one of its specific goals the international qualification of its faculty and staff. For achieving this goal, we may (1) promote the international and intercultural 'internationalization at home' to faculty, students and staff, involving a large part of the academic community in the internationalization process and providing support to cultural exchange by hosting professors, researchers, and foreigner students. Actions to achieve such results include attending events of student recruitment and training the academic community to personal interactions in other languages. Another strategy is (2) to offer training courses to professors specifically targeting internationalization. These training courses will focus on writing scientific papers for high impact journals and submitting proposals for international collaboration projects, which will be widely publicized to the academic community. A third strategy to achieve the goal above is to (3) identify new opportunities for faculty and staff for training courses abroad. We expect to increase the number postdoctoral periods abroad for the faculty, as well as to increase the number of staff trained abroad. Actions related to this strategy include identifying associations, groups, and organizations which offer postdoctoral, training and related scholarships abroad, widely publicizing such opportunities to faculty and staff. Besides, the plan includes a strategy to (4) create national and international mobility programs for staff, providing specific training. As results, we expect: to provide training on how to prepare mobility projects; to define strategic partners according to their expertise; and to establish new agreement aiming to national and international staff mobility. Actions that will be executed for this purpose include providing specific staff training and identifying internationalization initiatives from embassies, consulates, and institutions abroad.

#### **Counterparts offered by foreign partnership institutions, when applicable.**

We expect that foreign institutions receiving graduate students within the scope of the Institutional Internationalization Project of UFABC to provide adequate conditions for research and implementation of the actions foreseen in the research proposals here proposed. These conditions include laboratory infrastructure and access to libraries, biological collections (when necessary) and access to broadband internet. We also expect that Brazilian professors and researchers in overseas missions may have guaranteed appropriate conditions for research and execution of the actions foreseen in their research projects (laboratory infrastructure and access to libraries, biological collections, and broadband internet). In addition to the counterparts listed above, UFABC will prioritize partnerships with foreign institutions with reduction (or exemption) of academic and administrative fees. As an example of foreign partners' counterparts expected, there is the case of UFABC's agreement with the Alliance of Universities of the Ruhr Metropolitan Region (UA Ruhr) - Universität Duisburg-Essen, Ruhr-Universität Bochum, and Technische Universität Dortmund. This agreement, supported by UA Ruhr's office for Latin America, established in São Paulo, defines cooperation in strategic research areas with the possibility of exchange scholarships with UA Ruhr students within the scope of this Capes-Print Project. The DAAD (Deutscher Akademischer Austauschdienst), German funding organization for international exchange, will also offer fellowships for the exchange of researchers and students.

#### **Other counterparts, when applicable.**

The Institutional Plan of Internationalization of UFABC, approved by the University Council for the next five years (2018-2023), provides other institutional counterparts related to the Capes-Print Internationalization Project: Strategy (1): To devote proper budget towards internationalization activities. Expected results: and

increasing of the budget to cover the demands of the Institutional Plan of Internationalization for 2018 to 2023. Actions: to discuss with Graduate Programs and Strategic Research Units general and specific demands; and to verify, with UFABC President's Office, budget changes regarding new demands for internationalization. Strategy (2): To expand relations of UFABC with embassies and consulates. Expected results: offering more interaction channels with other countries and establishing a contact network to solve issues regarding international collaboration. Actions: to identify embassies and consulate that offer services and opportunities concerning the collaboration with institutions abroad dealing with teaching, scientific research, and outreach; to propose diplomatic events hosted in UFABC; and to search for cooperation opportunities at embassies and consulates. Strategy (3): To find public and private funding sources to support internationalization activities. Expected results: list of funding sources to support internationalization activities. Actions: to identify funding sources for internationalization activities foreseen at the Internationalization Institutional Plan and to publicize the information on institutional websites, also sending it by e-mail to Graduate Programs and the Strategic Research Units. Strategy (4): To provide logistical support and offices to host partners (researchers and students) from abroad on short-term visits. Expected results: infrastructure allowing the proper execution of international collaborative research activities. Actions: to identify and organize multipurpose workstations and offices for foreign visitors, creating a policy for its use.

