

Tipo de ayuda:

Type of call: Beatriz Galindo senior

Antigüedad necesaria:

Postdoctoral experience: 10 years

Part b.
Proyecto de necesidad docente de la Universidad
Educational Project as required by the University

The educational project is to be developed in the “Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos de Barcelona” (School of Civil Engineering) of the “Universidad Politécnica de Catalunya” (UPC BarcelonaTech) as part of the educational tasks performed by the “Department of Civil and Environmental Engineering”. More specifically, it focuses on the courses (or academic modules) in Continuum Mechanics and Structural Mechanics and Dynamics. These modules are transversal and required as a basis to several engineering disciplines (soil mechanics and geotechnics, fluid mechanics and hydraulic, structural engineering, construction...). Therefore, they are expected to propose examples of application pertaining to different fields of Civil and Environmental Engineering (CEE), but not necessarily restricted to the CEE (the School is proud of extending its scope beyond the CEE classical disciplines). Thus, applications of Continuum and Structural Mechanics to other fields than CEE are also welcome. Being instrumental for many CEE applications, the Continuum and Structural Mechanics disciplines are a cornerstone of the educational background provided in the School. Thus, maintaining the excellent level of education that characterizes the School in these disciplines is a strategic challenge when some of the key professors excelling in these topics are very close to retirement.

Consequently, the proposed educational program and planning pertains to these disciplines and, specifically, is taking as representative examples of them two Bachelor's and three Master's Degree courses. The approach is different for these two categories but, covering similar topics in different depths, it is important keeping thematic coherence in order to guarantee high-level learning outcomes. These modules,

despite of their fundamental scientific content, must provide the students with competences contributing to their professional Engineering career.

Bachelor's Degree courses. The project must include two courses in the Bachelor Degree in Civil Engineering.

- **Continuum Mechanics**, 9 ECTS, second year. In this course students will acquire an understanding of the laws of thermomechanics of continuous media and learn to apply them in engineering-related areas, such as fluid mechanics, mechanics of materials, structural theory, etc.
- **Structural Analysis**, 7,5 ECTS, third year. In this course Students will learn to apply their knowledge of structural analysis to calculate operational strength as part of the design of structures that comply with current regulations, with the help of analytical and numerical calculation methods.

These courses are of great strategical importance for the School of Civil Engineering because they allow extending and opening new viewpoints in the field of the CEE and the corresponding technologies. In particular, the Environmental implications are to be highlighted because they are directly aligned with our mission of contributing to the social development, showing a high sensitivity to the environmental care, management and protection. The two courses illustrate the duality in the two main disciplines that are collected under the umbrella of this position: Continuum Mechanics and Structural analysis. These two disciplines are intimately connected and therefore it is of special importance keeping (as it has been kept in this School all along its history) the fundamental character of Continuum Mechanics in the Structural Analysis and, conversely, conveying the applicational spirit of Structural Analysis into Continuum Mechanics.

Master's Degree courses. The project must include two courses in the “Master en Ingeniería de Caminos, Canales y Puertos (MICCP)” (Master in Civil Engineering), and a course in the “Master de Métodos Numéricos en Ingeniería (MNMI)” (having a special path as the Master of Science in Computational Mechanics, with the Erasmus Mundus distinction awarded by the European Commission).

- **Structural Engineering**, 6 ECTS, first year of MICCP. In this course Students will learn to apply their knowledge of structural engineering and to use advanced calculation methods to analyse, dimension and interpret the resistance behaviour of structures.
- **Numerical Models in Civil and Structural Engineering**, 5 ECTS, second year of MICCP. In this course is a specialization module in which knowledge on specific competences in structural is intensified. Students will deepen their knowledge in structural analysis for shape optimization, transient analysis (thermal and thermo-mechanical problems) and nonlinear analysis.
- **Computational Solid Mechanics**, 5 ECTS, first year of the MNMI. The course is centered on the numerical methods applied to the modeling of the behaviour of nonlinear materials in solids. It makes special emphasis on the integration of the constitutive models and the generalizations towards the nonlinear versions of the finite element method. The course includes the essential theoretical aspects as well as their practical applications.

It is worth mentioning that the development and applications in the fields of Computational Mechanics, both in Computational Solid Mechanics and in Fluid Dynamics lead up to a highly expanding professional activity: R+D+I industries such as aeronautical, automotive, healthcare... Such activities are strongly consistent with the research and knowledge-transfer requirements presented below.

The academic activities associated with this profile require the participation on high-level management and coordination tasks at the level of the strategic planning of the School and the Department. The ideal candidate has experience as senior academic manager and will be involved in the governing boards of the School and the Department, both as advisor and executive member.

The quality of the present educational project is directly linked with the required standards of our School to all the Degrees. In this case, the aforementioned Masters possess the Seal of Excellence (accreditations) given by AQU (Catalan Agency), ASIIN (German Agency) and EUR-ACE. In the case of the Bachelor's Degrees, it is worth noting that the current Bachelor in Civil Engineering and the new Bachelor in Civil Engineering Technologies (to be launched in September 2020) have groups completely taught in English, with special focus in training professionals for a global market. To promote these aspects, it is of the greatest importance incorporating a Senior professor with high qualifications in the overseas University system.

UPC participates in two International Campus of Excellence, the Barcelona Knowledge Campus (BKC, in collaboration with the University of Barcelona) and the Energy Campus. The BKC pursues the international projection of the UPC and has achieved the creation of the Sino-Spanish Campus in China as one of the initiatives. The Program in Computational Mechanics (as a branch of MNI) offers synergies with such initiative since the prestigious Tsinghua University is a partner which takes advantage of the BKC to attract students. In the same direction, the current teaching project is also directly connected with the objectives of the Energy Campus in the sense that the disciplines are essential to sustain developments in the field of energy (in particular renewable energy sources like hydro and wind, in which structural and fluid mechanics

are highly influential) environment and sustainability, of outmost importance for the strategies and mission of the Energy Campus.

Part c.

**Proyecto de necesidad de investigación y transferencia del conocimiento
Research and Transfer-of-Knowledge Project**

The required Research and transfer-of-knowledge Project is associated with the Continuum Mechanics and Structural Mechanics and Dynamics activities of the research groups of the Department of Civil and Environmental Engineering (DECA) of the School of Civil Engineering of the UPC. This is an extremely active discipline in the Department, with different groups that are international referents in the diverse aspects of the field. Just to name some topics, the expected research contributions are expected to contribute to advanced modelling in nonlinear solid mechanics, high-fidelity (high-order) numerical methods for geometrically nonlinear materials with applications to dynamic fracture, electro-magneto-mechanical active polymers and other advanced functional materials and data-driven models.

The dissemination of results is to be evaluated by the publication in indexed international journals with high impact, as well as international collaborations with other universities/laboratories with recognized prestige in related fields (in Europe, the Americas and Asia) and also complementary fields that may contribute to the international projection of the Department of Civil and Environmental Engineering and the UPC.

The candidate is expected to lead a research team in the fields of Continuum Mechanics and Structural Mechanics and Dynamics, with effective fund-raising capacities and a deep knowledge of the European funding schemes for science and technology.

One of the main objectives of the prospected research activities is to generate knowledge which furthermore aims to be transferred to both industrial and social sectors. Thus, special attention is paid to all initiatives regarding the needs and concerns

proposed by social and industrial organizations. In this way, the collaboration in supervision of doctoral theses associated with industrial doctorates and the participation in projects with industrial partners involved is of great importance in this position. These transfer-of-knowledge objectives are fully aligned with the research topics mentioned above. As a senior researcher, the candidate is expected to have a network of industrial partners and continue the knowledge-transfer activities from the UPC.

According to the previous statements, alignment with the transfer-of-knowledge strategy in the UPC demands collaboration and participation in industrial projects boosting the University-Industry transfer potential. Among other topics, intensive attention is to be devoted to the civil protection of structures, structural integrity and the simulation of fracturing problems in manufacturing, mining and other applications. A particular field of research in which different groups have already ongoing activities is the analysis and modeling of metamaterials (also named as architecture materials). This is a particularly active research field because the properties emerging from the micro-structure are conferring to the bulk material unexpected features. Having proper modeling tools is essential to design the micro-structure of such metamaterials, in order to obtain the desired mechanical, acoustical or electromagnetic properties.

All these fields have reached a mature R+D+I level, with a very strong scientific potential, and the University is able and open to provide solutions and establish new collaborations and projects, and also to consolidate those already ongoing. Thus, the research plan is to be in accordance and to be consistent with the trajectory of the candidate that will develop it.

To summarize, the research and transfer-of-knowledge Project focus on highly consolidated scientific disciplines with very strong potential.

Similar as the Educational Project, this Research Plan is closely linked with the objectives of both the International Campus of Excellence-Barcelona Knowledge Campus (BKC) and the Energy Campus. The BKC aims at giving added value to the shared space between UPC and Universidad de Barcelona, promoting the union of institutions (in both teaching and research activities) and industrial companies in order to become into a recognized and prestigious technological and scientific model. The proposed scope of the research plan is intended to play a very important role in the BKC due to its strong potential and current interest in the scientific community. Furthermore, the applications of the proposed research activities to the environmental and sustainability fields are directly connected to the objectives of the Energy Campus.

Part e.
Impacto deseado en la universidad
Expected impact in the university

The expected impact of this position in the university is described by detailing how it affects the aspects shown next.

The social and economic impact is guaranteed by boosting scientific research in fields related to Continuum Mechanics and Structural Mechanics and Dynamics, directly applied to high impact topics and with strong scientific interest, such as material science, structural integrity and manufacturing techniques and the challenging field of research developing data-driven models. Besides, and more specifically, it is intended to boost the applied research and the university-industry transfer-of-knowledge in fields where real time support for decision making is required.

We seek promoting the care in environmental and sustainable development by means of scientific projects and training of future professionals in the field. To do that, it is a priority the connection with the International Campus of Excellence-Barcelona Knowledge Campus (BKC) and the Energy Campus.

The impact of the educational project in the university is intended to push the newest teaching methodologies that could improve the learning quality and the attraction of students in the fields of CEE.

All this is intended to be aligned with the mission of making the UPC a prestigious university as an international reference in the mentioned scientific fields, and also in its educational offer. In particular, in the Bachelor's and Master's degrees from the Department of Civil and Environmental Engineering (DECA) of the School of Civil Engineering, already a school with strong international prestige and with an internationally oriented academic offer.

Moreover, it is necessary to guarantee the continuity of the teaching and scientific team of the DECA, specifically the division of Continuum Mechanics and Structural Mechanics, where a number of senior professors with a high international impact in this field are going to retire in the next few years.

This senior professorship position is also intended to guarantee the generational change of guard of a cohort of professors that founded the School as a referential institution in the European Civil and Structural Engineering landscape.