ASIIN Seal & European Label Accreditation Report

Master's Degree Programmes
Civil Engineering
Numerical Methods in Engineering

Provided by
Polytechnic University of Catalonia

Version: 09.12.2022

Table of Content

A About the Accreditation Process

Name of the degree programme (in original language)	(Official) English translation of the name	Labels applied for [1]	Previous accreditation (issuing agency, validity)	Involved Technical Committees (TC)[2]
Máster Universitario en Ingeniería de Caminos, Canales y Puertos	Civil Engineering	ASIIN, EUR-ACE® Label	2015-2020 ASIIN	03
Máster Universitario en Métodos Numéricos en Ingeniería	Numerical Methods in Engineering	ASIIN, EUR-ACE® Label	2015-2020 ASIIN	03
Date of the contract: 09.11.2021 **Submission of the final version of the self-assessment report:** 17.05.2022 **Date of the onsite visit:** 28.-29.06.2022 **at:** UPC North Campus, Barcelona				
Peer panel: FOR ASIIN: Prof. Dr.-Ing. Tim Ricken, University of Stuttgart Prof. Dr. rer. nat. Michael Schäfer, Technical University of Darmstadt FOR AQU: Francisco Agrela Saiz, University of Córdoba Sandra Garcia Galiano, Politechnic University of Cartegna Alicia Soria Gomez, Ecole polytechnique fédérale de Lausanne Xavier Llort Pavon, Hydrometeorological Innovative Solutions Francisco Joaquin Jimenez Gonzalez, Politechnic University of Cartegna				

[1] ASIIN Seal for degree programmes; EUR-ACE® Label: European Label for Engineering Programmes
[2] TC: Technical Committee for the following subject areas: TC 03 - Civil Engineering, Geodesy and Architecture

Representative of the ASIIN headquarter: Yanna Sumkötter	
Responsible decision-making committee: Accreditation Commission for Degree Programmes	
Criteria used: European Standards and Guidelines as of May 15, 2015 ASIIN General Criteria, as of December 10, 2015 Subject-Specific Criteria of Technical Committee 03 – Civil Engineering, Geodesy and Architecture as of September 28, 2012	

B Characteristics of the Degree Programmes

a) Name	Final degree (original/English translation)	b) Areas of Specialization	c) Corresponding level of the EQF[3]	d) Mode of Study	e) Double/Joint Degree	f) Duration	g) Credit points/unit	h) Intake rhythm & First time of offer
Civil Engineering	Máster Universitario en Ingeniería de Caminos, Canales y Puertos / Master's Degree in Civil Engineering	- structural and construction engineering - geotechnical engineering - water engineering - computational engineering - transportation engineering and urban planning - environmental engineering and sustainability	7	Full time, part time		4 semesters	120 ECTS	2012, every semester
Numerical Methods in Engineering	Numéricos en Ingeniería / Master's Degree in Numerical Methods in Engineering		7	Full time, part time		4 semesters	120 ECTS	2006, annually in the fall semester

For the Master's degree programme Civil Engineering (MCDE) the institution has presented the following profile on their website as well as in the self-assessment report:

"The Master's degree programme Civil Engineering is offered by the Barcelona School of Civil Engineering which is a school of higher education that was created in 1973 on the initiative of a series of Catalan road engineers and companies at the Polytechnic University of Barcelona, which in 1984 became the Polytechnic University of Catalonia. A board of trustees was set up to create it. One of the members set up a school model with a core of highly qualified professors, with an exclusive dedication to teaching and research that has persevered throughout the years. The School has a proven track record in the training of Civil Engineers, Public Works Engineers and Geological Engineers and is internationally recognized for the quality of its graduates, the high-level research carried out by its teaching staff through the 23 research groups recognized by the Generalitat de Catalunya and for their contribution to the social and economic progress of our country.

[3] EQF = The European Qualifications Framework for lifelong learning

The Master's degree programme in Civil Engineering provides advanced multidisciplinary and technological training that is supposed to enable students to work in research, design and analysis of infrastructure and civil engineering projects and qualify them to practice as a civil engineer. The curriculum reinforces the grounding in mathematics, physics, science and technology provided by the Bachelor's degree programme by teaching students the most advanced and experimental techniques for modelling in engineering. The Master's degree programme offers students the possibility to choose one of six areas of specialisation (Computational Engineering, Environmental Engineering & Sustainability, Geotechnical Engineering, Structural Engineering & Construction, Transport Engineering & Urbanism, Water Engineering) and includes study abroad at some of the most prestigious engineering schools in the world in the framework of mobility programmes and agreements.
The Master's degree promotes the acquisition and development of the skills needed for employment in national and international engineering firms, construction companies, consultancy firms, government organisations and research institutes. It provides future professionals with a solid technical basis for designing and overseeing the development of infrastructure and planning and managing environmental services and resources in order to contribute to spatial planning. Employment may also be sought in the supervision of maritime and coastal work teams, water resources and supply, structural design, spatial planning, logistics, transport and the environment, and computational mechanics, although civil engineers are also increasingly employed in various areas of business, thanks to their analytical skills and ability to solve complex problems, which are highly valued in industry and in the service sector."

For the Master's degree programme Numerical Methods in Engineering (MDNME) the institution has presented the following profile on their website as well as in the self-assessment report:

"The Master's degree programme Numerical Methods in Engineering is offered by the Barcelona School of Civil Engineering which is a school of higher education that was created in 1973 on the initiative of a series of Catalan road engineers and companies at the Polytechnic University of Barcelona, which in 1984 became the Polytechnic University of Catalonia. A board of trustees was set up to create it. One of the members set up a school model with a core of highly qualified professors, with an exclusive dedication to teaching and research that has persevered throughout the years. The School has a proven track record in the training of Civil Engineers, Public Works Engineers and Geological Engineers and is internationally recognized for the quality of its graduates, the high-level research carried out by its teaching staff through the 23 research groups recognized by the Generalitat de Catalunya and for their contribution to the social and economic progress of our country.

Nowadays, the industrial sector requires accurate and reliable numerical simulations of

product and process design: students of the Master's degree in Numerical Methods in Engineering learn how to simulate, predict and optimise any problem in the field of engineering through computational mechanics. Given the cross-disciplinary and global nature of this field, and in order to enhance the international profile of its graduates, this study programme is taught in English.

The Master's degree in Numerical Methods in Engineering provides in-depth multidisciplinary training in the field of numerical methods. The objective of the study programme is to train students in developing and applying numerical methods in engineering, particularly in the field of computational mechanics. Basic subjects include continuum mechanics, numerical algebra, programming and finite element methods, and application topics are focused on structural mechanics, fluid mechanics and manufacturing processes. Graduates of this study programme specialise in the theory and applications of computational methods for product and process design.“

C Peer Report for the ASIIN Seal[4]

1. The Degree Programme: Concept, content & implementation

Criterion 1.1 Objectives and learning outcomes of a degree programme (intended qualifications profile)

Evidence

- Diploma Supplement
- Self-assessment report
- Competence-subject matrices
- Website per programme, where detailed lists of competences are published
- Discussions during the audit

Preliminary assessment and analysis of the peers:

For the two study programmes, the university presents a detailed description of general programme goals in the self-assessment report (SAR) and, in particular, on each programme's website. The peers approve that for each programme a detailed presentation of learning outcomes and graduates' attributes is given in combination with learning outcome matrices matching the described learning outcomes with the respective modules of the programmes. The very informative websites contain brief but explicit descriptions of the programmes objectives, clearly stating the professional fields and specializations of the offered degree programmes as well as programmes particularities. The peers acknowledge that the learning outcomes and curricula of all programmes were developed and are adapted jointly with students, alumni and industry representatives.

Graduates of the Master's degree programme Civil Engineering shall have a profound knowledge of the physical-mathematical and scientific-technical areas through the use of the most advanced and experimental techniques of modelling in engineering. Moreover, during their studies, students should acquire the capacity for critical, logical and analytical

[4] This part of the report applies also for the assessment for the European subject-specific labels. After the conclusion of the procedure, the stated requirements and/or recommendations and the deadlines are equally valid for the ASIIN seal as well as for the sought subject-specific label.

reasoning. In addition, they should gain analysis, design, calculation, project, planning, construction maintenance, management competences as well as extensive problem solving skills. They shall be able to integrate knowledge and handle the complexity of making judgments based on information that includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments. In addition to these general technical competences, specific competences are defined for each specialization.

In the case of the Master's degree programme Numerical Methods in Engineering, the graduates should be able to apply numerical methods to solve problems and should acquire competences in the application of numerical methods through the use of calculation programmes, pre and post graphic processors, programming languages and scientific calculation libraries. They should have the capacity for searching, analysing, compilating and synthesising cutting-edge scientific and technical information, particularly in research and innovation in all areas of numerical methods. Moreover, they shall know how to apply innovative solutions and make progress in the knowledge to exploit new paradigms of numerical methods.

Next to the professional skills, the students of the two degree programmes are supposed to acquire interdisciplinary, personal and social competences. These include awareness of legal aspects of civil engineering and numerical methods and its effects on society. Furthermore, students shall acquire practical skills and be able to apply the theoretical knowledge during the practical sessions. Other social competences include effective communication, English language skills, the capacity to work in teams. In particular in the two master's programs, students shall also acquire project management and leadership skills as well as the ability of conducting independent research.

The peers conclude that, in formulating the intended learning outcomes for the two degree programmes, the university has followed the EUR-ACE framework standards of engineering programmes and the Subject-Specific Criteria of the ASIIN Technical Committee 03 for Civil Engineering, Geodesy and Architecture. The peers confirm that the study aims and learning outcomes of the two Master's degree programmes correspond to level 7 of the European Qualifications Framework. They aim at the acquisition of specific competences and are described in a brief and concise way. They are well-anchored, binding and easily accessible to all stakeholders.

Criterion 1.2 Name of the degree programme

Evidence:

- Self-assessment report

- Website per programme
- Diploma supplement per programme

Preliminary assessment and analysis of the peers:
The original names of the study programmes are *Máster Universitario en Ingeniería de Caminos, Canales y Puertos* for the Master's degree programme Civil Engineering and *Máster Universitario en Métodos Numéricos en Ingeniería* for the Master's degree programme Numerical Methods in Engineering. The Civil Engineering degree programme is taught in Spanish, Catalan and English whereas the Numerical Methods in Engineering degree programme is implemented entirely in English. The expert panel considers the names of the study programs to be adequately reflecting the respective aims, learning outcomes, and curricula as well as the language of instruction.

Criterion 1.3 Curriculum

Evidence:

- Self-assessment report
- Website per programme, where the module descriptions are published
- Competence-subject matrices
- Study plan per programme

Preliminary assessment and analysis of the peers:
The curricula of the two study programmes under consideration are reviewed by the peers in order to identify whether the described programme objectives and learning outcomes can be achieved by the available modules. Course descriptions as well as overviews and competence-subject matrices matching the general learning objectives and the module contents were provided for a thorough analysis. In the self-assessment report, the university gives a detailed overview of how the competences acquired with the presented curricula match the individual EUR-ACE learning outcomes.

The Master's degree programme Civil Engineering lasts two years and thus consists of four semesters, during which the students acquire 120 ECTS in total. These are divided among compulsory credits (60 ECTS: 30 ECTS within the expansion of scientific and technological education and 30 ECTS within advanced science and technology applications), specialization credits (35 ECTS, one specialization to be chosen) and the Master's thesis (25 ECTS). The curriculum of the Civil Engineering degree programme is based on the related Ministry Order regulating the studies in Civil Engineering in Spain. It is designed to provide a solid

background in different aspects of research in civil engineering, while preparing the students to become experts in any of the fields of specialization offered. At the end of the second semester, the students choose one (out of six) specializations. The specializations offered are: Computational Engineering, Environmental Engineering and Sustainability, Geotechnical Engineering, Structural Engineering and Construction, Transportation Engineering and Urban Planning as well as Water Engineering. In the fourth semester, students will have to conduct their research activities, while guided by a supervisor. Additionally, students of the Civil Engineering degree programme are required to spend at least one semester abroad if not already done during their previous Bachelor's studies. This regulation is supposed to ensure that every student of the degree programme has been exposed to a mobility experience at some point. From the students the peers learn that they appreciate the mobility regulation, because UPC offers a wide range of partnership agreements.

The Master's degree programme Numerical Methods in Engineering lasts two years and thus consists of four semesters, during which the students acquire 120 ECTS in total. These are divided among compulsory credits (75 ECTS), optional credits (15 ECTS, to be chosen between three elective courses or internship) and the Master's thesis (30 ECTS). The curriculum imparts knowledge and hands-on experience in a wide range of Numerical methods fields: students learn how to simulate, forecast and optimize any problem in the field of engineering through computational mechanics. This is to be achieved through courses in the finite elements, advanced fluid mechanics, computational mechanic tools and programming for engineers and scientists. In the third semester, besides mandatory courses that are supposed to train soft skills (entrepreneurship and communication skills 1 and 2), students must choose between three elective courses (in the area of reduced order modelling, numerical models in civil and structural engineering and machine learning and models for decision making) or the internship. This modification has been introduced in 2020 and is based on the observation that the competencies of the internship could be matched to a selection of other courses providing practical skills in selected areas. Moreover, this allows to improve the attractiveness of the degree programme by introducing new courses in the field of machine learning. The possibility to choose between these options is very much appreciated by the students, as it allows them to set personal accents and to individually shape their studies according to their interests. In the fourth semester, students will have to conduct their research activities, while guided by a supervisor. Given the universality of this discipline, this programme is fully taught in English.

With regard to the internships, the peers learn that the fieldwork practice in companies usually takes 3 months in the Numerical Methods in Engineering degree programme. As described above, students have the possibility to choose between three elective courses and the internship in the third semester of their studies. The students who choose to do

the internship value this possibility as it allows them to apply the skills they learned in the study programme in a real working environment. Regarding the Civil Engineering degree programme, the internship is voluntary and must be completed as part of extracurricular activities. During the on-site visit, the peers learn that most of the students decide to do an internship while being enrolled in the degree programme. The number of working hours is limited and depends on the number of credits enrolled in order to avoid an increase in the students' workload. In order to get a better overview of the existing internship opportunities, students have access to a list of participating companies via the online learning platform. The university has established useful guidelines for these internships and every student has one supervisor at the company and one at the university to ensure that the work contributes to achieving the programme's learning outcomes. The representatives of the industry are also generally content with the way these internships are organised by UPC.

Finally, the peers ask how soft skills are trained within the two degree programmes. While in the Numerical methods in Engineering degree programme, students must take three mandatory courses that are supposed to train soft skills (entrepreneurship and communication skills 1 and 2), there are no specific courses to strengthen the soft skills of the students in the Civil Engineering degree programme. Soft skills are trained there within the framework of regularly conducted projects. The students learn to work out solutions together in a group, to present them in a report and to explain them in a subsequent presentation. From the industry representatives, the peers learn that the students from UPC are particularly flexible and resilient in many respects: both in terms of competition and in terms of their perseverance. In spite of this, the industry representatives also underline that specific soft skills as the ability to communicate and to publically speak and present in front of an audience, could still be improved in the Civil Engineering degree programme. Consequently, the peers recommend to strengthen those skills, for instance by providing feedback to students on their performance.

All in all, the peers have a very good impression of the curricula of the two degree programmes. By thoroughly analyzing the module descriptions and following the discussions during the on-site visit, the peers state that the two curricula are coherent and well structured. The individual modules build upon and complement each other in a meaningful, appropriate way.

Criterion 1.4 Admission requirements

Evidence:

- Faculty website that gives information on admission to Master's degrees

- General academic access requirements
- Specific admission requirements per programme
- Self-assessment report
- Discussions during the online audit

Preliminary assessment and analysis of the peers:
The admission requirements are published on the website and thereby accessible for all potential students or other stakeholders. The peers acknowledge that set rules and regulations formally stipulate the admission requirements and process.

The general admission criteria for Master's degree programmes at UPC demand an official Spanish university qualification or an official university qualification issued by a university in the European Higher Education Area (EHEA) that qualifies the holder for admission to a Master's degree. In case that the qualification has been issued by a university in a country that is not in the EHEA and that the qualification has not been homologated, UPC will verify that the course of study corresponds to a level of education equivalent to an official Spanish university degree and that the qualification obtained would provide admission to a Master's degree in the country in which it was awarded. Moreover, Master's degree programme are also open to UPC Bachelor's degree students who have not been awarded the bachelor's degree yet because they have not completed the bachelor's thesis and up to 9 ECTS credits (including credits pending recognition or transfer) or they have not yet attained the cross-disciplinary competency in a foreign language, if applicable. The school responsible for a Master's degree may set additional conditions on credits pending for these Bachelor's degree students, or prevent them from gaining admission via this route. Under no circumstances will students be awarded a Master's degree without having first been awarded a Bachelor's degree. Furthermore, holders of an official university degree corresponding to curricula in accordance with the first additional provision of Royal Decree 822/2021 may be considered for admission to a Master's degree provided that they hold an official undergraduate degree or an official university diploma.

In addition, for the two Master's degree programmes specific admission criteria are defined and presented on the programme websites. As the admission criteria for the Master's degree programme Civil Engineering are regulated by the Spanish law to ensure that the corresponding degree qualifies the holder to practise the regulated profession of Civil Engineer, only students with a Bachelor's degree in Civil Engineering (or equivalent) can access the programme. Students with equivalent engineering degrees are assigned extra preparatory courses before they can begin the Master's degree programme if their background is deemed unsatisfactory by the board of examiners. The admission is denied if more than 30

ECTS are necessary. In order to gain admission to the Master's degree programme in Numerical Methods in Engineering applicants must have completed a Bachelor's or a diploma degree in the fields of mechanical, electrical, materials, civil, aeronautical, systems, mining, naval, telecommunications, physics, forest or agricultural engineering. Access to the programme is also granted to Bachelor's or diploma degree graduates in mathematical, physical, chemical, biological or geological sciences. If the diploma or degree is different from the ones listed above, the Academic Committee in charge of the Master's degree will assess the applicant's curriculum in order to grant them access and establish the necessary preparatory courses. The admission is denied if more than 30 ECTS are necessary. In terms of language requirements, an English B2 level certificate (CEFR) is required for both Master's degree programmes.

For each academic year, UPC determines the ratio of students admitted through these different ways. Generally, the number of applications is higher than the number of admitted students. For the academic year 2017/18, there were 145 applications whereas 102 students were admitted in the Civil Engineering degree programme. For the academic year 2019/20, both values are 88 and 68 whereas for the academic year 2021/22, both values are 95 and 69. The statistical data shows that the number of applications in the Civil Engineering degree programme has been decreasing since the academic year 2017/18 and has been increasing for the last three years. From the programme coordinators, the peers learn that this trend is justified by the decrease in graduates from the Bachelor's Degrees that gives access to the Civil Engineering degree programme. In the Numerical Methods in Engineering degree programme both values are 34 and 8, 43 and 28 and 19 and 11 for the same academic years. The statistical data shows that the number of applications has been decreasing over the last three years. From the programme coordinators, the peers learn that this trend is justified by the fact that half of the students who attend the courses of the programme are not officially enrolled in this same programme, but enrolled in other, related degree programmes such as Master'degree Mathematics. However, these students are not reflected in the corresponding statistical data. The peers can understand these explanations, but also ask the industry representatives about it. The peers learn from them that despite the high demand for graduates from the Numerical Methods in Engineering degree programme, not all vacancies can be filled. Therefore, the peers recommended to further develop and intensify the marketing and the associated recruitment of new students in order to increase student numbers.

The tuition fees for the programmes are determined by the Catalan government. There are different levels for these fees, according to the credit points envisaged to be achieved after every semester. Furthermore, there are various options for scholarships that cover the tuition fees.

In summary, the admission website informs potential students in great detail about the requirements and the necessary steps to apply for admission into the programmes. Since the rules are based on decrees by the ministry of education and on the university's written regulations, the peers deem them binding and transparent. They confirm that the admission requirements support the students in achieving the intended learning outcomes.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 1:

Since UPC does not address this in its statement, the peers stick to their previous impression.

2. The degree programme: structures, methods and implementation

Criterion 2.1 Structure and modules

Evidence:

- Website per programme
- Module descriptions
- Self-assessment report
- Discussions during the audit

Preliminary assessment and analysis of the peers:

The two degree programmes under review are designed for 2 years and the students need to achieve 120 ECTS. Each semester is equivalent to 15 weeks of learning activities, including one week for final exams.
After analyzing the module descriptions and the curricula, the peers confirm that the two degree programmes under review are divided into modules and that each module is a sum of coherent teaching and learning units. The peers appreciate the clearly presented structure of the degree programmes on their websites and consider the layout of the programmes and the individual modules useful in order to achieve the overall intended learning outcomes. While the Numerical Methods in Engineering degree programme includes a fixed curriculum as described above and various elective courses or external internship option, the Civil Engineering degree programme encompasses specialization options with a

fixed curriculum which allow students to develop an individual profile and to arrange their syllabus accordingly. The students are satisfied with the range of specializations and electives. The industry representatives confirm the need and the use of these.

As a general rule for Master's degrees at the university, 12 ECTS have to be passed within the first year. Additionally, the remaining 48 ECTS of the first year have to be achieved at the end of the second year at the latest. The peers consider this practice as adequate in order to ensure that students have the required fundamental knowledge to follow advanced courses.

The two degree programmes can be studied in part-time as well. Part-time students may enroll in a minimum of 15 ECTS and a maximum of 60 ECTS per year for the duration of the degree course. Accordingly, the duration of the Master's degree programmes extends to a maximum of 4 years in total. However, after the initial phase (60 ECTS passed), the university cannot distinguish anymore between part- and full-time students as the students pay per credit and therefore, decide on an individual basis for how many courses they enroll each semester irrespective if they are full- or part-time students.

Several coordination mechanisms have been devised for the two degree programmes. The academic staff responsible for the subjects constitutes the first level of coordination mechanisms, and this is usually a senior or expert professor. Each area of the common compulsory modules as well as each specialization is assigned a coordinator. All coordinators meet at least once a year with both Heads of Studies. The ultimate responsibility for the coordination of studies lies with the Head of Studies. All Master's degree programmes have the same coordination structure. The coordination is implemented in three different levels: at the program year level, at the area level (i.e. group of courses in the same area) and global. The area coordinator is responsible for distributing the learning objectives and competences among the courses in the area. The global coordination ensures the coordination among areas and semesters. This global coordination is one of the tasks of the Master's Academic Committee, and there is one for each Master's degree programme. In addition, generic competences or professional skills deserve specific coordination due to their transverse nature. The panel welcomes these coordination mechanisms, as they ensure that the modules are consistent within themselves, are matched against each other, build upon each other and consequently, viewed all together to support the intended academic level.

The two degree programmes prepare the students well for their later professional life by different means: generally, the projects for the final thesis are usually directly related to practical issues of professional life and can be undertaken at a university research group, a company or a foreign university. There are voluntary internships in the Civil Engineering degree programme, an optional internship in the Numerical Methods in Engineering degree

programme and very good relations to local and international enterprises. The faculty has established and maintained relationships with many future employers who offer paid internships, fellowships and trainee programmes. Both, employers and students seem very satisfied with the offered internships.

In summary, the peers gain the impression that the choice of modules and the structure of the curriculum ensures that the intended learning outcomes of the respective degree programme can be achieved.

Mobility

The self-assessment report as well as the discussions make it clear that, while striving to become an international acknowledged university, international recognition is one of UPC's primary goals for the next years. The peers point out that international mobility, with regard to the lecturers as well as to the students, is a key factor in these efforts.

The peers learn that UCP provides many different opportunities for students to conduct double degrees, internships, summer schools and study semesters abroad in order to broaden their horizon and to define a more specific focus of study. The peers note that the demand for taking such international opportunities is constantly increasing, because the faculty is actively encouraging them and offering cooperation agreements with organisations in over 30 attractive target countries worldwide (for instance USA, France, China, Italy). The peers appreciate that the obligatory proof of the B2 proficiency level in English as an admission requirement as well as the fact that the Numerical Methods in Engineering degree programme is fully taught in English support the increase of the demand for international activities. Qualifications obtained at other universities in Spain or abroad are recognised in line with the courses at UPC. The recognition of externally acquired competences is regulated at university, not at school level. It is stipulated in the Academic Rules of the university, published on the website. The peers consider these to be in line with the expectations of the Lisbon Convention. The students can best realise such a stay in semesters 3 to 4 or, in case of a shorter stay, during the holidays. As they confirm, there are no problems with credit transfer or the organisation of student mobility.

Criterion 2.2 Work load and credits

Evidence:

- Website per programme
- module descriptions
- Self-assessment report

- Discussions during the visit

Preliminary assessment and analysis of the peers:
The workload in both degree programmes is spread evenly with each semester containing 30 ECTS according to the regular study plan. The workload of the last semester is markedly reduced to give the students enough time for their theses as well as to already start looking for a job. Under any circumstances, 12 ECTS have to be passed within the first year. Additionally, the remaining 48 ECTS of the first year have to be achieved at the end of the second year at the latest.This mechanism is supposed to ensure that the students can really handle the workload. The peers confirm that the allocation of ECTS credits to lectures, practical sessions and self-study periods of the modules appear plausible. The workload documentation clearly states the workload distribution between lectures and independent student work and is made transparent in the module descriptions. The defined practice of continuous assessment further described under criterion 3 avoids structure-related peaks in the workload and enables students to complete the degree without exceeding the regular course duration. The student workload is evaluated through surveys at the end of each semester. The faculty asks students to participate in a survey on the number of hours dedicated to a subject, correlating this information with the final grade of the students in the subject. This serves as a feedback for the lectures that shall help detect any anomalous situation with regard to the activities.

However, with regard to the distribution of the workload, the peers note that in the module descriptions of both degree programmes, the workload does not match the credit points awarded in the Master's thesis module. According to UPC's academic regulations 1 ECTS equals 25 hours of student work. The Master's thesis of the Master's degree Civil Engineering is worth 25 ECTS and thus corresponds to 625 hours of student work. However, the corresponding module description only indicates 26 hours of workload. The same applies to the Master's degree programme Numerical Methods in Engineering: while the Master's thesis is worth 30 ECTS and thus corresponds to 750 hours of student work, the corresponding module description only indicates 376 hours of workload. During the discussion with the students, the peers learn that this must be a typing error in the module descriptions as they confirm that the workload of the Master's thesis module is manageable and matches the actual workload. Therefore, with regard to the information that is provided in the module descriptions, UPC must ensure that the workload matches the credit points awarded in the Master's thesis module of both degree programmes.

During the discussion with the students, they emphasise that they consider the workload high but manageable. UPC provides statistical data about the average length of studies and the number of dropouts. According to the data, the average study period of the students

from the Civil Engineering degree programmes is 2,6 years for the last four academic years, while it is 2,3 years for the Numerical Methods in Engineering degree programme. According to the SAR, this is especially due to the Covid19 pandemic, which slightly delayed some Master's thesis defences, and thus delayed graduation. Moreover, a lot of students have work next to studying. Additionally, they see that almost all students complete the degree programmes as there are only in average 21 % of the students who dropped out of the Numerical Methods in Engineering degree programme between the academic years 2016/17 and 2019/20. In the Civil Engineering degree programme there are only about 2 % of the students who dropped out of the programme during the same period of time. From the programme coordinators, the peers learn that the Numerical Methods in Engineering class of the academic year 2018/19 had an exceptionally high dropout rate. A more accurate analysis of the reasons for this is based on the fact that it was an 8-student class (who enrolled in the Master's degree in the academic year 2017/18), which amplifies the effect of any deviation. Of these 8 students, 1 student was delayed defending his Master's thesis. Another student left the programme for work reasons, because he had to supervise a big project, but has the intention to complete the Master's degree in the near future. Two more students have actually dropped out of school. Nevertheless, the peers note that the dropout rates are in average relatively low and can understand that the standard period of study is sometimes slightly exceeded, but that this has personal reasons or is due to the restrictions of Covid19 pandemic and not to the design of the programmes. On the contrary, the peers are convinced that the data verifies that both degree programmes under review can be completed in the expected period and that the responsible programme coordinators take appropriate measures to enable students to successfully complete their studies in a standard period of study. However, since the self-assessment report and the provided evidences show contradictory statistical data on drop-out rates for the academic year 2021/22 of the Numerical Methods degree programme, the peers ask the university to submit the corresponding correct data with the statement.

Criterion 2.3 Teaching methodology

Evidence:

- module descriptions
- Self-assessment report
- Discussions during the visit

Preliminary assessment and analysis of the peers:
The two programmes under review make use of several different educational methods for each course such as interactive lectures, small group discussions, problem-based learning, project-based learning, analysis and problem solving tasks, computer-based assignments, excursions and final tasks consisting of internship, seminars and final project and case-study. In addition, an online teaching platform (Atenea "CaminsOpenCourseWare") with specific teaching support tools is implemented allowing students to receive additional educational material or online feedback on their assignments. The teaching and learning is supported by a broad range of media, both traditional (books, papers) and online (videos, presentations etc.). In the course of the Covid19 pandemic, the faculty has swiftly switched to online learning with videoconferences, recorded videos and other media. Moreover, projects are conducted in several modules in the two degree programmes. These do not only focus on the practical application of the theoretical knowledge but also require the students to do research, both independently and in group. The labs, which are well equipped (see also criterion 5.3), allow for adequate and state-of-the-art teaching. However, from the students, the peers learn that they are generally satisfied with the teaching as such, but mention that they would much appreciate having more laboratory work included in the traditional lectures. They explain that it would be useful to translate the simulation taught in theoretical lectures into a physical problem by means of an experiment in the laboratory. Especially in the elective courses, for instance in the "seismic risk assessment and reduction" course in the specialization area "structural engineering and construction" of the Civil Engineering degree programme, the feedback of the learned knowledge would find meaningful application in the laboratory. Therefore, the peers recommend to include the laboratories more strongly into the elective courses of both degree programmes.

Overall, the panel considers the teaching methods used for implementing the didactical concept as appropriate and the ratio of contact hours to self-study time seems to support the achievement of the intended learning objectives.

Criterion 2.4 Support and assistance

Evidence:

- Self-assessment report
- Discussions during the visit

Preliminary assessment and analysis of the peers:
In order to support students in completing their studies on time with good achievements,

the university and the faculty provide academic and personal support and assistance through various means. The offers can be divided into two types: academic support and non-academic supports. Academic advice includes the mentoring programme, the International Office, the programme coordinators, the Dean and the supervisors for the internships and Master's thesis. Non-academic supports comprises the Sports Centre, the Language Centre, the Employment Centre for graduates, the library, computer laboratories, the Technology Centre and student dormitories.

The relation between lecturers and students is considered to be one of the strong points of the programmes. The peers get the impression that close relations exist between students and teachers. They also positively acknowledge that teaching staff and programme coordinators are very accessible for students' requests. In addition, the faculty has developed a new mentoring concept ("tutoring action plan") in order to offer students intense support, in particular first-year students.

During the tutoring action plan, each first year student is assigned a tutoring group and a tutor. This mentoring concept is intended to support the adaptation, learning and professional orientation of new students, to provide elements of training, information and academic guidance in a personalized way, to promote the acquisition of study techniques and habits through individual and group tutoring and to monitor the student's performance throughout the academic year. Apart from regular meetings, the tutor and the students can communicate, convene meetings, exchange information and documentation via a dedicated online platform. At the end of the first academic year, each tutor issues a final report. In addition, every student who enrols for the Master's thesis course will be assigned two thesis supervisors. The role of the thesis supervisors is to help students to complete their thesis research; they also monitor the progress of the thesis in order to ensure the completion of the thesis in the intended amount of time. The students confirm towards the peers that they are supervised in the research group during their work on the Master's thesis. There are regular meetings where the students present their results and receive feedback from the other members.

General advice and guidance are covered by the UPC Office for Equal Opportunities, the International Office and the Employment Centre for graduates. The wide range of support and service initiatives positively influences the study success of the students. However, the peers note that while the percentage of female students in the Civil Engineering degree programme has been between 30 % and 50 % in the last four academic years, the distribution is much lower in the Numerical Methods in Engineering degree programme at 0 % to 25 %. From the programme coordinators, the peers learn that the faculty is currently intensifying its advertising measures for the degree programme. Information events such as the Open Day are intended to present the degree programme in a more attractive way. They additionally point out that the Barcelona School of Civil Engineering is well positioned

in terms of the proportion of female lecturers, as it employs 45 female and 178 male teachers. Furthermore, female teachers are given preferential treatment in new appointments and promotions. The peers take note of this, but still recommend to develop a concept for increasing female students and to implement it consistently in the Numerical Methods in Engineering degree programme.

The employability of the school's graduates is very high, also due to a variety of networking activities organized by the school itself. Employers offer paid internships to senior students and both employers and graduates demonstrate a high level of satisfaction with the support provided by the teaching staff. In addition, the faculty organizes the "Futur Civil Day" every year, a forum that hosts different companies in the field of civil engineering who send their head-hunters to scout new talents at the Barcelona School of Civil Engineering. In the run-up to the fair, the faculty sends a number of students CV's to the relevant companies. Based on the vacant positions, the companies select students with whom they then conduct interviews on the day of the fair and recruit for internships.

The peers welcome that all information is published on the programme websites. There are enough resources available to provide individual assistance, advice, and support for all students. The support systems help the students to achieve the intended learning outcomes and to complete their studies successfully and without delay. The students are well informed about the services available to them. Overall, the peers judge the extensive support system to be one of the strong points of UPC.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 2:

Criterion 2.2:

UPC provided the correct statistical data about drop-outs together with its response statement. UPC also explained the reasons for the contradictory statistical data in their response statement. The official data is uploaded in two periods: the first upload is provisional and takes place in the month of December. This first upload was made on 10 December 2021. The second upload is of the final data and takes place in the month of June; in this case, on 14 June 2022.

The data that appeared in the accreditation self-report of 28 March 2022 refer to the provisional upload in December, whereas the data that were subsequently viewed by the External Evaluation Committee that evaluates the master's degree refer to the upload of June 2022 (the final data). Therefore, the data in the second upload varied slightly with respect to the data presented in the self-report in March.

In the first upload (December), a dropout rate of 28.57% was collected on the new entry cohort of the 2018-2019 academic year, which is calculated in the 2020-2021 academic year; likewise, it showed a graduation rate of 33.33% for the same cohort.

The problem occurred in the June 2022 upload, in which an error affected the dropout and graduation rates for the master's degree. Specifically, it was incorrectly stated that the dropout rate was 52.4% and the graduation rate was 28.6%.

After reviewing the data and correcting the upload error, the final figure for the dropout rate is 28.57% and the final figure for the graduation rate is 38.1%. This means that the graduation rate increased because five more students from the 2020-2021 graduation year graduated between December 2021 and June 2022. One of them is part of the 2018-2019 new entry cohort and therefore changes the graduation rate from 33.33% to 38.1%. Consequently, the peers are convinced that, also according to the average study duration (see above), the data verifies that the Numerical Methods in Engineering degree programme can be completed in the expected period and that the responsible programme coordinators take appropriate measures to enable students to successfully complete their studies in a standard period of study.

With regard to the workload that needs to match the credit points awarded in the Master's thesis module of both degree programmes, UPC described in its response statement that there has been an error in the description modules of the master's thesis regarding the workload. UPC provided updated module descriptions for both degree programmes. The module descriptions now contain the following information: the Master's thesis of the Master's degree Civil Engineering is worth 25 ECTS and thus corresponds to 625 hours of student work. The Master's thesis of the Master's degree programme Numerical Methods in Engineering is worth 30 ECTS and thus corresponds to 750 hours of student work. As the module descriptions have been updated and as the students confirmed during the audit discussions that the workload of the Master's thesis module is manageable and matches the actual workload, the peers consider this requirement to be fulfilled.

3. Exams: System, concept and organisation

Criterion 3 Exams: System, concept and organisation

Evidence:

- Module descriptions
- Academic regulations
- Sample exams, projects and final theses

- Self-assessment report
- Discussions during the audit

Preliminary assessment and analysis of the peers:
Each course has to determine objectives, which support the achievement of the Programme Learning Outcomes of the respective programme. Accordingly, each course must assess whether all defined learning outcomes stated in the module description have been achieved.

According to the self-assessment report, exams, assignments, projects and presentations are employed to assess the students' achievement of the learning outcomes and are in their concept and variety fully satisfactory. Oral examinations do occur in the form of presentations (in project works, for instance) and as part of the final theses. The two degree programmes include a final Master's thesis which ensures that students work on a set task independently.

The peers discuss with the students how many and what kind of exams they have to take each semester. They learn that each course-content in the reviewed study programmes is reflected in exams, which take place in the form of continuous assessment, as they are divided into subject-specific assignments, mid-term examinations, and final examinations. The peers as well as the students welcome this kind of learning assessment as it allows a close monitoring of the students' learning progress and encourages students' motivation throughout the semester so that they do not have to solely work for one final exam at the end of the semester. By this way of helping students to consciously assess their actual state of knowledge, the assessment procedure at the same time contributes to an adequate exam preparation.

The organization of the exams guarantees examinations that avoid delay to students' progressions. The relevant rules for examination and evaluation criteria are transparently put into a legal framework, as both students and lecturers confirm in the audit discussions. At the first meeting of a course, the students are informed about what exactly is required to pass the module. The form and length of each exam is mentioned in the course descriptions that are available to the students via UPC's website and the online learning platform (Atenea). The date and time of the exams are announced in due time in the academic calendar of the university. Except for the first year modules, no re-examinations are offered to the students. However, all mandatory modules are offered every semester, so students may register again in the next semester. The final grade of each module is calculated based on the score of these individual kinds of assessment. The exact formula, usually 30 % for assignments and 70 % for final exam, is given in the module handbook. UPC uses a grading system with the grades 0 to 10, where a 5 is necessary to pass a module.The peers confirm

that rules have been defined for disability compensation measures, illness and other mitigating circumstances.

Shortly before the on-site visit, the peers were provided with a selection of exams and Master's theses to analyze. They confirm that these represent an adequate level of knowledge as required by the EQF level 7 for the two Master's degree programmes.

Every student is required to do a final thesis in the last semester. Prior to the actual research work, the students are required to write a research proposal which has to be presented in the corresponding research group and accepted by the Dean and the supervisor committee who will then appoint the thesis supervisors. Usually, there are two supervisors for each student. One will act as the principal supervisor and the other act as co-supervisor. In case the student writes her or his thesis in collaboration with the industry, she or he is also assigned a supervisor from the industry. After completing the work on the Master's thesis, the student has to present and defend the results in front of a jury and fellow students.
However, from the programme coordinators and the students, the peers learn that the university sometimes grants students a longer period of compilation for the thesis than the intended four months. They explain that this is especially due to the fact that the students pay study fees according to the credit points envisaged to be achieved after every semester, and a Master's thesis, which is worth 25 ECTS, makes up a significant part of the whole study time. Other students complete an internship parallel to their Master's thesis, which is due to a personal choice. This leads to some students postponing the defence of their thesis to the following semester. Consequently, the peers recommend that the thesis supervisors pay more attention to the fact that students adhere to the duration of the thesis as specified in the module descriptions. Specifying the topic of the thesis before applying might help.

In conclusion, the peers note that all relevant examination regulations are in place and well communicated in a transparent way. The forms of exams are oriented toward the envisaged learning outcomes of the respective courses, and the workload is distributed in an acceptable way.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 3:

Regarding the recommendation that the thesis supervisors pay more attention to the fact that students adhere to the duration of the thesis as specified in the module descriptions, UPC explained in its response statement that thesis directors usually recommend that Master's theses should be completed in the specified time and offers are designed to do so. However, UPC points to the fact that the UPC regulations allow the period for presenting the Master's thesis to be extended. It is not easy to change this regulation because it is a UPC government competence and not School competence. However, efforts will be made to encourage students to finish in the time originally planned. The peers take note of this and encourage the university to further pay more attention to the fact that students adhere to the duration of the thesis as specified in the module descriptions.

4. Resources

Criterion 4.1 Staff

Evidence:

- Staff handbook
- Self-assessment report
- Discussions during the audit

Preliminary assessment and analysis of the peers:

The faculty's staff members have different academic positions. There are professors and lecturers. Professors with permanent positions in Spain can be employed by the national Spanish Government (civil servants) or by the regional government. Their positions distinguish between full professors, associate professors, and assistant professors. Lecturers are professionals who work outside the university and are experts in a certain field. They are hired on a temporary and part-time basis to contribute with their knowledge and professional experience to the university. Consequently, lecturers teach professional-oriented subjects. Thus, the faculty combines the academic approach offered by permanent academic staff with a professional perspective provided by non-permanent academic staff. In the academic year 2020/21, the faculty accommodated 204 academic staff members, out of which 70 % hold a doctoral degree (46 were full professors).

By thoroughly examining the provided CVs of the staff members involved in the programmes, the peers confirm that the composition, scientific orientation and qualification

of the teaching staff are suitable in order successfully implement and sustain the degree programmes. The peers are impressed by the excellent and open-minded atmosphere among the students and the staff members. Both confirm that in case of questions or problems, there is always an academic advisor available to solve the issues together with the student. The academic staff is supported by the administrative and technical employees at department, faculty, and university level.

The academic staff is involved in a high number of research projects funded by grants from the Catalan government, the university itself or other research funds. This results in numerous publications. Frequently, students are involved in these projects, mostly through their Master's theses.

In summary, the peers confirm that the composition, scientific orientation and qualification of the teaching staff are suitable for successfully implementing and sustaining the degree programmes.

Criterion 4.2 Staff development

Evidence:

- Self-assessment report
- Discussions during the audit

Preliminary assessment and analysis of the peers:
The ICE (in Catalan, Institut de Ciències de l'Educació) of the UPC offers training courses for teaching staff who wish to further develop their professional and teaching skills. The Barcelona School of Civil Engineering actively supports and encourages their teaching staff to attend the training offers. The school also has academic staff participating in research and projects on innovation in teaching methods, as well as the use of modern educational technologies in accordance with the EHEA framework. The teaching staff confirms that the offered trainings are useful and well received.

The peers discuss with the members of the teaching staff the opportunities to develop their personal skills and learn that the teachers are satisfied with the internal qualification programme at the university, their opportunities to further improve their didactic abilities and to spend some time abroad to attend conferences, workshops or seminars. The university has implemented a specific programme for sabbaticals that provides access to a paid leave for a maximum duration of 12 months. The aim of this action is to promote the research activity of the selected persons. During the on-site visit, the peers get the impression that the teaching staff is dedicated to research and therefore many of them are motivated to

take a research semester. The peers appreciate the funding opportunities that allow regular sabbatical leaves, as they are of great importance.

All in all, the peers consider the measures taken for staff development as adequate and beneficial for the implementation of the programmes.

Criterion 4.3 Funds and equipment

Evidence:

- Self-assessment report
- Photo material
- On-site visit of the laboratories
- Discussions during the online visit

Preliminary assessment and analysis of the peers:
UPC is a public university and is funded by the national and regional government. The university budget is managed at two levels: a centralized budget and a delegated budget for each faculty and department. The central administration manages the centralized budget, which includes the staff salaries, major investments and financial operations for the whole university. The faculties are provided with a delegated budget for some current expenses such as teaching and lab materials. They are also allowed to keep a share of particular incomes, such as those from educational cooperation agreements or classroom rental. The peers get the impression that the financial resources are overall sufficient in order to implement the study programs successfully.

In the self-assessment report, the faculty gives a detailed overview of the available learning spaces, the library, online platforms and service, and the labs used for the two degree programmes. During the on-site visit, the faculty offers a guided tour of the campus with its most relevant research and teaching facilities as well as laboratories available for the two study programmes. The peers confirm that the resources for teaching and learning, in particular classrooms, computer rooms, laboratories and library are sufficiently well maintained and adhere to the international standard. The premises are spacious and offer ample opportunities for the professional and individual development of students and teachers. The university has licensed Microsoft Office and other standard software and provides the students full access to this software. The students confirm that they are provided with all relevant software and are given easy access to all necessary rooms and equipment.

In summary, the peers assess the available funds, technical equipment and infrastructure as sufficient and satisfactory to adequately sustain the study programmes.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 4:

Since UPC does not address this in its statement, the peers stick to their previous impression.

5. Transparency and documentation

Criterion 5.1 Module descriptions

Evidence:

- Module descriptions per programme

Preliminary assessment and analysis of the peers:
The module descriptions are published on each programme's website in English, Catalan and Spanish, so that students and stakeholders can access them at any time.

After studying the module descriptions, the peers confirm that they include all necessary information about the persons responsible for each module, the teaching methods and work load, the credit points awarded, the intended learning outcomes, the applicability, the admission and examination requirements, and the forms of assessment, recommended literature as well as details explaining how the final grade is calculated.

However, the peers realize that the module description of the internship that students can choose in the second year of the Numerical Methods in Engineering degree programme is missing. Therefore, they urge UPC to ensure that the latest version of the corresponding module description is made accessible for students and teaching staff.

Criterion 5.2 Diploma and Diploma Supplement

Evidence:

- Sample graduation certificate per programme
- Sample diploma supplement per programme
- Sample transcript of records per programme

Preliminary assessment and analysis of the peers:
With the successful completion of their studies, the students receive a graduation certificate, a transcript of records, and a diploma supplement. The diploma supplements are trilingual (Catalan, Spanish and English) and contain all relevant information on the student's

qualifications profile and individual performance as well as the classification of the degree program with regard to its applicable education system.

Criterion 5.3 Relevant rules

Evidence:

- Website per programme
- Academic regulation per programme
- Admission requirements
- Discussions during the audit

Preliminary assessment and analysis of the peers:

The peers confirm that the rights and duties of both the university and the students are clearly defined and binding. All rules and regulations are published on the university's website in Catalan, Spanish and English and hence are available to all relevant stakeholders. However, during the discussion with students the peers learn that the English version of the website of the website does not display the wealth of information that the Catalan and Spanish versions of the website do. Therefore, the peers recommend that the English, Spanish and Catalan websites are prepared consistently so that the same amount of information is provided on all websites. This is particularly important in order to attract international students.

In addition, students receive all relevant course materials in the language of the degree program at the beginning of each semester.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 5:

Criterion 5.1:

UPC provided the module description for the internship of the Master's degree programme in Numerical Methods in Engineering together with its response statement. The module description can be consulted from the master's website, "curriculum, calendars & regulations" section, or in a printable version. As the latest version of the corresponding module description has been made accessible for students and teaching staff, the peers consider this criterion to be fulfilled.

Criterion 5.3:

With regard to the recommendation that the English, Spanish and Catalan websites should be prepared consistently so that the same amount of information is provided on all websites, UPC describes in its response statement that the websites of the two Master's degree programmes hosted by the School of Civil Engineering are identical. However, UPC admits that some related links to external pages of the UPC do not have a correspondence in the three languages. Therefore, UPC plans to open an improvement action in order to make these external links accessible in the three languages. The peers appreciate that UPC plans to improve the even distribution of information on the three websites and support these actions.

6. Quality management: quality assessment and development

Criterion 6 Quality management: quality assessment and development

Evidence:

- Faculty website
- Monitoring and verification reports
- Self-assessment report
- Discussions during the visit

Preliminary assessment and analysis of the peers:

The peers discuss the quality management system at UPC with the programme coordinators. The peers learn that UPC and the Barcelona School of Civil Engineering have a multifaceted quality management system that aims at a constant development and improvement of the procedures, the programmes and all individual stakeholders. The university applies both external and internal quality assurance. The external quality assurance is implemented by the Catalan accreditation agency AQU and international accreditation, while UPC's internal quality assurance is managed mainly on faculty level.

The programme coordinators underline that the reliance on students' feedback and the necessity to ensure and improve the employability of the graduates are of major importance to them. Students complete the voluntary online questionnaire at the end of each course; the questionnaire was developed by the course survey committee and includes questions with respect to the course in general and about the teachers' performance. The results of the online surveys are announced at the end of the semester and are communicated to the students through a course representative. Additionally, they are discussed in

class. In case the satisfaction of the students with staff members is deficient, the Heads of Department will contact the respective teacher, discuss the issue and propose solutions. If no improvement can be achieved over a longer period, the staff member will be dismissed. The discussion with the students revealed that those in charge are always eager and open for feedback aside from the official evaluations and that students have the impression that their comments are taken into consideration with regard to the further improvement of the programmes. Moreover, the results of the regular module evaluations are effectively analyzed in bimonthly committee meetings and steps for improvements are taken. Equally, students and employers are represented in the Quality Committee, which specifically ensures continuous enhancement of programme quality through the analysis of objective data. The committees responsible for the design of the degree programmes took into account stakeholders' needs by consulting graduates, employers and professional associations. The industry representatives confirm in the discussion that the university is eager to receive feedback about new developments and trends and the employability of their graduates. This is mainly done through common projects, personal contacts and the forum "Futur Civil Day" which is hosted by the Barcelona School of Civil Engineering every year. Thus, the peers agree that the quality management circles at UPC are well established and work under participation of all stakeholders.

In addition to the formal and systematic quality assurance mechanisms, the peers appreciate the close relation between students and teachers which contributes to an atmosphere of confidence.
Furthermore, the peers ask to what extent alumni are involved in the quality management processes. From the programme coordinators, the peers learn that they play active parts in these processes by involving them in teaching through guest presentations or as lecturers. Two professors from the Numerical Methods in Engineering degree programme, for instance, have launched a pilot project to anchor a new course on entrepreneurship in the curriculum. To this end, they have engaged an alumni of the programme as a lecturer who recently founded a start-up and is to share his experiences with the students. In order to benefit from these personal contacts of the professors in a more structured way and, if necessary, to be able to take appropriate measures for the two curricula, the peers recommend to introduce a structured alumni network. One possibility would be to carry out further surveys by gathering statistics about alumni.

Final assessment of the peers after the comment of the Higher Education Institution regarding criterion 6:

Since UPC does not address this in its statement, the peers stick to their previous impression.

D Additional Documents

Before preparing their final assessment, the panel ask that the following missing or unclear information be provided together with the comment of the Higher Education Institution on the previous chapters of this report:

For the Master's degree programme Numerical Methods in Engineering:

D 1. Module descriptions for all modules including internship

D 2. Correct statistical data about drop-out rates

E Comment of the Higher Education Institution (24.10.2022)

The institution provided a detailed statement as well as the following additional documents:

- Updated module descriptions for internship module (Numerical Methods in Engineering degree programme)
- Updated module descriptions for thesis module (Numerical Methods in Engineering and Civil Engineering degree programmes)
- Statistical data about drop-out rates (Numerical Methods in Engineering degree programme)
- Link to websites (English, Spanish and Catalan version) of both degree programmes

F Summary: Peer recommendations (15.11.2022)

Taking into account the additional information and the comments given by UPC the peers summarize their analysis and final assessment for the award of the seals as follows:

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
Ma Civil Engineering	Without requirements	30.09.2030	EUR-ACE®	EUR-ACE (Depending on the decision of the ENAEE Administrative Council)
Ma Numerical Methods in Engineering	Without requirements	30.09.2030	EUR-ACE®	EUR-ACE (Depending on the decision of the ENAEE Administrative Council)

Recommendations

For all degree programmes

E 1. (ASIIN 5.3) It is recommended that the English, Spanish and Catalan websites are prepared consistently so that the same amount of information is provided on all websites.

E 2. (ASIIN 6) It is recommended to introduce a structured alumni network.

E 3. (ASIIN 2.3) It is recommended to include the laboratories more strongly into the elective courses.

E 4. (ASIIN 3) It is recommended that the thesis supervisors pay more attention to the fact that students adhere to the duration of the thesis as specified in the module descriptions.

For Numerical Methods in Engineering degree programme

E 5. (ASIIN 1.4) It is recommended to further develop and intensify the marketing and the associated recruitment of new students in order to increase student numbers.

E 6. (ASIIN 2.4) It is recommended to develop a concept for increasing female students and to implement it consistently.

For Civil Engineering degree programme

E 7. (ASIIN 1.3) It is recommended to strengthen the soft skills of the students, in particular their communication and presentation skills.

G Comment of the Technical Committee 03 – Civil Engineering, Geodesy and Architecture (21.11.2022)

Assessment and analysis for the award of the ASIIN seal:

The Technical Committee discusses the accreditation procedure and follows the assessment of the peers without any changes.

Assessment and analysis for the award of the EUR-ACE® Label:

The Technical Committee deems that the intended learning outcomes of the degree programmes do comply with the engineering specific parts of Subject-Specific Criteria of the Technical Committee 03 – Civil Engineering, Geodesy and Architecture.

The TC 03 – Civil Engineering, Geodesy and Architecture recommends the award of the seals as follows:

Degree Programme	ASIIN Seal	Maximum duration of accreditation	Subject-specific label	Maximum duration of accreditation
Ma Civil Engineering	Without requirements	30.09.2030	EUR-ACE®	EUR-ACE (Depending on the decision of the ENAEE Administrative Council)
Ma Numerical Methods in Engineering	Without requirements	30.09.2030	EUR-ACE®	EUR-ACE (Depending on the decision of the ENAEE Administrative Council)

Recommendations

For all degree programmes

E 1. (ASIIN 5.3) It is recommended that the English, Spanish and Catalan websites are prepared consistently so that the same amount of information is provided on all websites.

E 2. (ASIIN 6) It is recommended to introduce a structured alumni network.

E 3. (ASIIN 2.3) It is recommended to include the laboratories more strongly into the elective courses.

E 4. (ASIIN 3) It is recommended that the thesis supervisors pay more attention to the fact that students adhere to the duration of the thesis as specified in the module descriptions.

For Numerical Methods in Engineering degree programme

E 5. (ASIIN 1.4) It is recommended to further develop and intensify the marketing and the associated recruitment of new students in order to increase student numbers.

E 6. (ASIIN 2.4) It is recommended to develop a concept for increasing female students and to implement it consistently.

For Civil Engineering degree programme

E 7. (ASIIN 1.3) It is recommended to strengthen the soft skills of the students, in particular their communication and presentation skills.

H Decision of the Accreditation Commission (09.12.2022)

Assessment and analysis for the award of the ASIIN seal:

The Accreditation Commission discusses the accreditation procedure and follows the assessment of the peers without any changes.

Assessment and analysis for the award of the EUR-ACE® Label:

The Accreditation Commission deems that the intended learning outcomes of the degree programmes do comply with the engineering specific parts of Subject-Specific Criteria of the Technical Committee 03 – Civil Engineering, Geodesy and Architecture.

The Accreditation Commission decides to award the following seals:

Degree Programme	**ASIIN Seal**	**Maximum duration of accreditation**
Ma Civil Engineering	Without requirements	30.09.2030
Ma Numerical Methods in Engineering	Without requirements	30.09.2030

The Accreditation Commission recommends the award of the seals as follows:

Degree Programme	EUR-ACE Label	Maximum duration of accreditation
Ma Civil Engineering	Without requirements	Depending on the decision of the ENAEE Administrative Council
Ma Numerical Methods in Engineering	Without requirements	Depending on the decision of the ENAEE Administrative Council

Recommendations

For all degree programmes

E 1. (ASIIN 5.3) It is recommended that the English, Spanish and Catalan websites are prepared consistently so that the same amount of information is provided on all websites.

E 2. (ASIIN 6) It is recommended to introduce a structured alumni network.

E 3. (ASIIN 2.3) It is recommended to include the laboratories more strongly into the elective courses.

E 4. (ASIIN 3) It is recommended that the thesis supervisors pay more attention to the fact that students adhere to the duration of the thesis as specified in the module descriptions.

For Numerical Methods in Engineering degree programme

E 5. (ASIIN 1.4) It is recommended to further develop and intensify the marketing and the associated recruitment of new students in order to increase student numbers.

E 6. (ASIIN 2.4) It is recommended to develop a concept for increasing female students and to implement it consistently.

For Civil Engineering degree programme

E 7. (ASIIN 1.3) It is recommended to strengthen the soft skills of the students, in particular their communication and presentation skills.

Appendix: Programme Learning Outcomes and Curricula

According to the self-assessment report the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master's degree programme Civil Engineering:

"**Basic competencies**

- **CB6** Possessing and understanding knowledge that provides the basis or opportunity to be original in the development and/or application of ideas, often in a research context.
- **CB7** For students to know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
- **CB8** For students to be able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.
- **CB9** For students to know how to communicate their conclusions (and the knowledge and ultimate reasons that support them) to specialized and non-specialized audiences in a clear and unambiguous way.
- **CB10** For students to possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

General competencies

- **CG1** Scientific-technical and methodological training for the continuous recycling of knowledge and the exercise of the professional functions of assessment, analysis, design, calculation, project, planning, direction, management, construction, maintenance, conservation and exploitation in the field of Civil Engineering.
- **CG2** Understanding of the multiple technical, legal and property conditions that arise when projecting a public work, and the ability to establish different valid alternatives, choose the optimal one and translate it properly, anticipating construction issues, and employing the most appropriate methods and technologies, both traditional and innovative, with the purpose of

achieving the highest efficiency and favoring progress and a sustainable and environmentally friendly development of society.

- **CG3** Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Civil Engineer.
- **CG4** Knowledge of the history of civil engineering and training to analyze and value public works in particular and construction in general.
- **CG5** Knowledge of the profession of Civil Engineering and of the activities that can be carried out in the field of civil engineering.
- **CG6** Knowledge to apply technical and managerial skills in R+D+i activities within the field of civil engineering.
- **CG7** Ability to plan, project, inspect and direct infrastructure works for land (roads, railways, bridges, tunnels and urban roads) or maritime (port works and facilities) transportation.
- **CG8** Knowledge of the issues in the design and construction of the different elements of an airport and of the conservation and operation methods.
- **CG9** Ability to plan and manage hydraulic and energy resources, including the management of the whole water cycle.
- **CG10** Ability to carry out studies on land planning, the coastal environment, coastal planning and defense, and environmental aspects related to infrastructures.
- **CG11** Capacity for the design, execution and inspection of structures (bridges, buildings, etc.), foundation works and underground works for civil use (tunnels, parking lots), and the diagnosis of their integrity.
- **CG12** Ability to plan, design and manage infrastructures, as well as their maintenance, conservation and exploitation.
- **CG13** Ability to plan, carry out studies and design surface or underground water reservoirs (dams, pipes, pumps).
- **CG14** Ability to carry out studies, land and urban planning plans and urbanization projects.
- **CG15** Ability to evaluate and environmentally condition infrastructure works in projects, construction, rehabilitation and conservation.
- **CG16** Ability to plan and execute water purification treatments, including their desalination, and purification. Collection and treatment of waste (urban, industrial or even dangerous).
- **CG17** Ability to apply business management techniques and labor legislation.
- **CG18** Adequate knowledge of the scientific and technological aspects of mathematical, analytical and numerical methods in engineering, fluid mechanics, continuous media mechanics, structural calculation, civil engineering, maritime engineering, hydraulic works and uses and linear works.

Cross-disciplinary competencies

- **G1** INNOVATION, EMPLOYABILITY, DEVELOPMENT & RESEARCH. Ability to develop creativity and the tendency to innovation, in a way that affects the development and progress of society. Ability to work on a research topic. Employability at a management level in all types of companies and administrations, with initiative and decision-making skills.
- **G2** SUSTAINABILITY & ENVIRONMENT. Ability to develop engineering within the framework of globalization, sustainability and environmental protection. Ability to analyze the complete life cycle of an engineering project.
- **G3** THIRD LANGUAGE AT A SCIENTIFIC-TECHNOLOGICAL DEVELOPMENT LEVEL. Knowing a third language, which will be English due to its global nature, fluently not only orally but also in writing and in line with the needs of graduates studying a master's degree. In particular, being able to prepare a technical or scientific article for international publication. At the end of the master's degree program, students must achieve a level C of English language.
- **G4** USE OF INFORMATION RESOURCES AT AN INTERNATIONAL LEVEL. Ability to acquire information in both general and specialized international databases. Ability to access the most innovative and recent proposals, ability to carry out comparative studies as well as to detect strengths and weaknesses.
- **G5** CAPACITY TO DEVELOP KNOWLEDGE. Ability to develop new analysis methodologies and processes at all levels from conception, to project and development. Ability to propose and develop engineering specifications, regulations and standards, following criteria of safety, efficiency and sustainable use of resources.
- **G6** CAPACITY FOR THE PROMOTION & MANAGEMENT OF ENGINEERING PROJECTS. Ability to study the needs of society and their transformation into infrastructure and service projects. Ability to draft, develop and implement projects based on knowledge of basic subjects and technologies, decision making, directing the activities that are the object of the projects, assessing the social and environmental impact of the technical solutions adopted, estimation of economic, material and human resources involved in a project.

Specific competencies

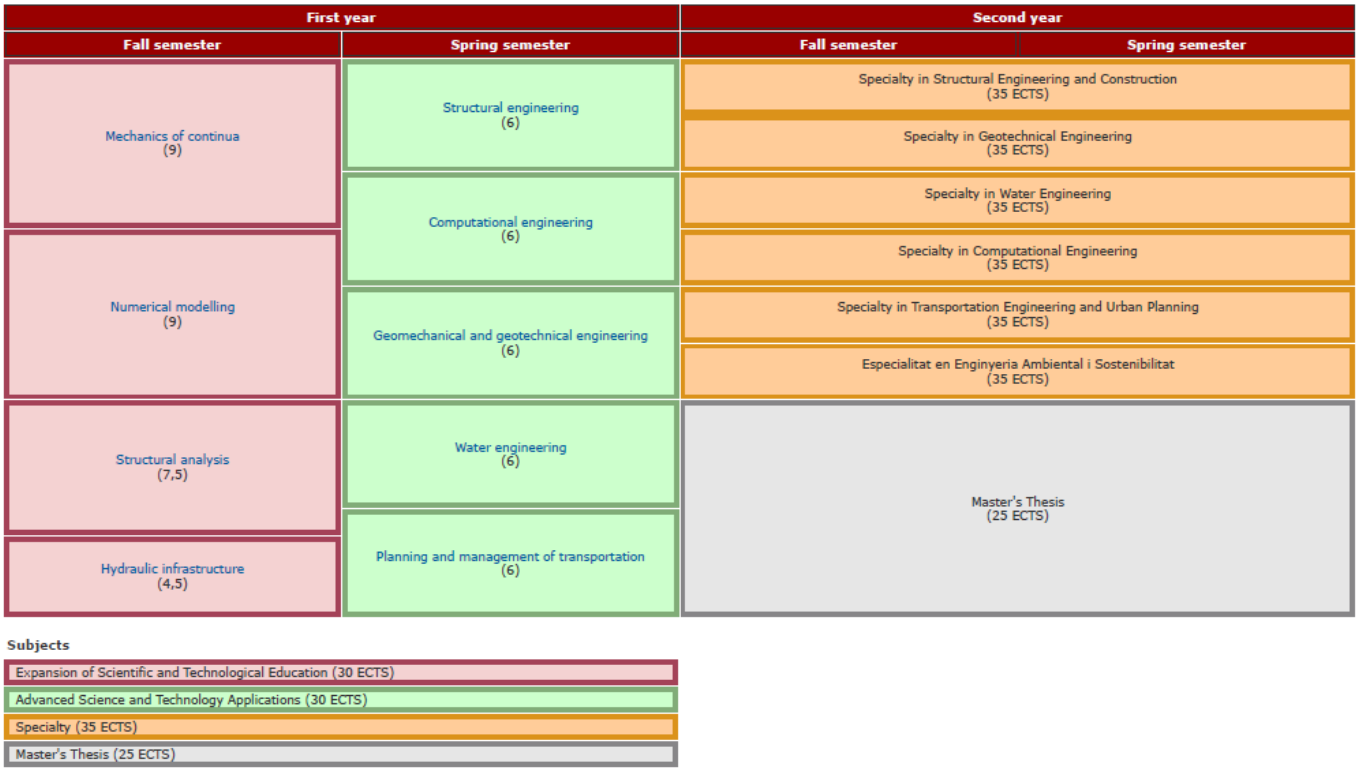
- **AFC1** Ability to tackle and solve advanced mathematical engineering problems, from problem statement to formulation development and implementation in a computer program. In particular, the ability to formulate, program and apply advanced analytical and numerical calculation models to the project, planning and management, as well as the ability to interpret the results obtained, in the context of civil engineering.
- **AFC2** Understanding and mastery of the laws of thermo-mechanics of continuous media and the ability to apply them in areas of engineering such as mechanics of fluids and materials, theory of structures, etc.
- **CienTec1** Application of the knowledge of the mechanics of soils and rocks for the development of the study, project, construction and exploitation of foundations, slides, embankments, tunnels and other constructions carried out on or through the ground, whatever the nature and its status, and whatever the purpose of the work in question.
- **CienTec2** Knowledge and capacity for structural analysis by applying the methods and programs of design and advanced calculation of structures, based on the knowledge and understanding of the demands and their application to the structural typologies of civil engineering. Ability to perform structural integrity assessments.
- **CienTec3** Knowledge of all types of structures and their materials, and ability to design, project, execute and maintain civil works structures and buildings.
- **CienTec4** Ability to project, evaluate, build and maintain hydraulic works.
- **CienTec5** Ability to perform the calculation, evaluation, planning and regulation of water resources, both in surface and underground.
- **CienTec6** Ability to design and size water purification and treatment systems, as well as waste.
- **CienTec7** Knowledge and skills that allow understanding the dynamic phenomena of the ocean-atmosphere-shore environment and being able to provide answers to the problems posed by the coastline, ports and shores, including the impact of interventions in the coastline. Ability to carry out maritime works studies and projects.
- **CienTec8** Knowledge of transportation engineering and planning, transportation functions and modes, urban transport, management of public transport services, demand, costs, logistics and financing of transport infrastructures and services.
- **CienTec9** Ability to analyze and diagnose the social, cultural, environmental and economic conditions of a territory, as well as to carry out land and urban planning projects from the perspective of sustainable development.
- **CienTec10** Ability to plan, manage and exploit infrastructures related to civil engineering.

- **TFM** Elaboration, presentation and defense, once all the credits of the study plan have been completed, of an original dissertation carried out individually before a university court, consisting of a comprehensive Civil Engineering project professional in nature and in which the competencies acquired in the classroom are synthesized.

The following **curriculum** is presented:

Master's Degree in Civil Engineering

Year 2020/2021



Subjects

- Expansion of Scientific and Technological Education (30 ECTS)
- Advanced Science and Technology Applications (30 ECTS)
- Specialty (35 ECTS)
- Master's Thesis (25 ECTS)

- **Specialty Courses**

According to the self-assessment report the following **objectives** and **learning outcomes (intended qualifications profile)** shall be achieved by the Master's degree programme Numerical Methods in Engineering:

Basic competencies

- **CB6** Possessing and understanding knowledge that provides the basis or opportunity to be original in the development and/or application of ideas, often in a research context.

- **CB7** For students to know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
- **CB8** For students to be able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.
- **CB9** For students to know how to communicate their conclusions (and the knowledge and ultimate reasons that support them) to specialized and non-specialized audiences in a clear and unambiguous way.
- **CB10** For students to possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

General competencies

- **CG1** Knowledge of numerical methods and solution mechanisms. Complete and consolidate the basic student training in solving problems using numerical and computational methods, reinforcing their knowledge of the basics, as well as of the specific applications.
- **CG2** Knowledge of the theories and applications of numerical methods. Ability to acquire advanced knowledge and understanding of the theories and applications of numerical methods in solving engineering problems.
- **CG3** Experience in solving problems using numerical methods. Ability to acquire experience and criteria in the application of numerical methods through the use of calculation programs, pre and post graphic processors, programming languages and scientific calculation libraries.
- **CG4** Consolidation of the application criteria of numerical methods. Complete and consolidate the knowledge, criteria and critical spirit to propose conventional solutions and as well as to analyze the results in characteristic numerical modeling problems.
- **CG5** Knowledge of social networks in the field of numerical methods. Knowing and acquiring a critical awareness about the avant-garde of the Spanish, European and international community of numerical methods in engineering.
- **CG6** Numerical modeling of real problems. In depth ability to solve real engineering problems through numerical modeling by identifying the underlying mathematical model, the most appropriate calculation method and the critical interpretation of the results.
- **CG7** Independence to question. Acquire the ability to autonomously use their knowledge and understanding of computational engineering to design solutions to new or unfamiliar problems, incorporating theoretical and practical knowledge and

know-how, if necessary, from other disciplines of engineering and basic sciences, and designing new original resolution methods appropriate to the set of final objectives.

- **CG8** Knowledge of the scope of numerical methods. Understand the applicability and limitations of numerical modeling and existing calculation technologies.
- **CG9** Independence to research. Acquire experience and autonomy in the search, analysis, compilation and synthesis of cutting-edge scientific and technical information.

Cross-disciplinary competencies

- **CT1** CAPACITY FOR ENTREPRENEURSHIP & INNOVATION. Knowing and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results between the different socio-economic agents involved in R+D+I processes, acquiring thus the ability to lead a work team made up of various professional profiles and disciplines.
- **CT2** SUSTAINABILITY & SOCIAL COMMITMENT. Being able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and choices.
- **CT3** THIRD LANGUAGE. Having English as a third language, at an appropriate level in oral and written form, so as to being able to work and communicate effectively in international and intercultural environments.
- **CT4** EFFECTIVE ORAL AND WRITTEN COMMUNICATION. Improving communication skills: oral presentations, preparation of professional and scientific reports in a clear and concise way to communicate their conclusions, the knowledge and ultimate reasons that support it, to specialized and non-specialized audiences in a clear and unambiguous way.
- **CT5** TEAM WORK. Being able to work as a member of an interdisciplinary team, not only as a member, but also to perform management tasks in order to contribute to developing projects with pragmatism and a sense of responsibility, assuming commitments considering the resources and time available. Obtaining a good knowledge of the community of numerical methods in engineering at a national and international level.
- **CT6** SOLVENT USE OF INFORMATION RESOURCES. Managing the acquisition, structuring, analysis and visualization of data and bibliographic and computer information of a scientific and technical nature and critically assess the results of this management.
- **CT7** SELF-EMPLOYED LEARNING. Detecting gaps in one's own knowledge and overcome them through critical reflection and the choice of the best action to expand

this knowledge and motivate oneself to continue training throughout their professional life.

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Specific competencies

- **CE1** Knowledge of practical numerical modeling. Ability to acquire knowledge in advanced numerical modeling applied to different areas of engineering such as: Civil and environmental engineering, Mechanical and aerospace engineering, Nano-engineering and bioengineering, Naval and marine engineering, etc.
- **CE2** Knowledge of the state of the art in numerical algorithms. Ability to catch up on the latest numerical technologies to solve engineering and applied science problems.
- **CE3** Knowledge of modeling materials. Ability to acquire knowledge related to modern physical models in material science (advanced constitutive models) in solid and fluid mechanics.
- **CE4** Knowledge of validation and verification criteria. Management capacity of numerical simulation quality control techniques (validation and verification).
- **CE5** Experience in numerical simulations. Acquisition of fluency in modern numerical simulation tools and their application to multidisciplinary engineering and applied science problems.
- **CE6** Interpretation of numerical models. Understanding the applicability and limitations of different computer calculation techniques.
- **CE7** Experience in programming calculation methods. Ability to acquire training in the development and use of existing calculation programs, as well as pre and post processors, knowledge of programming languages and standard calculation libraries.

The following **curriculum** is presented:

Master's Degree in Numerical Methods in Engineering

Year 2021/2022

First year		Second year		
Fall semester	Spring semester	Fall semester	Fall and spring semesters	Fall and spring semesters
Mandatory courses	Mandatory courses	Mandatory courses	Elective courses (External internship or the 3 elective courses)	Master's Thesis
30 ECTS	30 ECTS	15 ECTS	15 ECTS	30 ECTS
75 ECTS				
120 ECTS				

*** Check the semester the courses are taught in the following table.**

Code	Course	ECTS	Semester	Professor in charge	Observations
Mandatory courses (1st year - Fall semester)					
250950	Numerical methods for pdes	5	Fall semester	Zlotnik Martinez, Sergio	10Q1(English)
250951	Finite element	5	Fall semester	De Pouplana Sardà, Ignasi	10Q1(English)
250952	Continuum mechanics	5	Fall semester	Agelet De Saracibar Bosch, Carlos	10Q1(English)
250954	Advanced fluid mechanics	5	Fall semester	Saez Viñas, Pablo	10Q1(English)
250960	Communication skills 1	5	Fall semester	Garcia Gonzalez, Alberto	10Q1(English)
250961	Computational mechanics tools	5	Fall semester	Sarrate Ramos, Josep	10Q1(English)
Mandatory courses (1st year - Spring semester)					
250956	Computational solid mechanics	5	Spring semester	Oliver Olivella, Francisco Javier	10Q2(English)
250958	Computational structural mechanics and dynamics	5	Spring semester	Cervera Ruiz, Luis Miguel	10Q2(English)
250957	Finite elements in fluids	5	Spring semester	Giacomini, Matteo	10Q2(English)
250963	Coupled problems	5	Spring semester	Codina Rovira, Ramon	10Q2(English)
250970	Domain descomposition and large scale scientific computing	5	Spring semester	Rossi Bernecoli, Riccardo	10Q2(English)
250955	Programming for engineers and scientists	5	Spring semester	Zlotnik Martinez, Sergio	20Q2(English)
Mandatory courses (2nd year - Fall semester)					
250964	Entrepreneurship	5	Fall semester	Belles Ros, Francesc Xavier	10Q1(English)
250965	Advanced discretization methods	5	Fall semester	Sala Lardies, Esther	10Q1(English)
250967	Communication skills 2	5	Fall semester	Dialami Shabankareh, Narges	10Q1(English)
Elective courses (2nd year - Fall and spring semesters)					
250971	Reduced order modelling	5	Fall semester	Ryzhakov, Pavel	10Q1(English)