Guide to Applying the Generic Student Outcomes Framework to Engineering Programs.

This guide aims to deploy, clarify, and nuance some terminological or application aspects of the cross-curricular competencies framework and its student outcomes to programs in the field of engineering.
For this purpose, we have considered the accreditation criteria [1] set forth by the international accreditation reference for these disciplines assumed in our institution, which is the Engineering Commission (EAC) of ABET.

Definitions

The following nuances should be considered in formulating the competencies and the learning outcomes assigned to each of them.

- **Scope of the discipline:** in these degrees, the discipline is understood as **engineering** in general and the specifics established by the CIN standards of each program or, failing that, the objectives, competencies, and specific learning outcomes established for each of them. (RA 1.4, RA 1.2).

- **Principles of the discipline:** in general, the **principles of engineering, science, and mathematics** will be considered as principles of the discipline (RA 5.1, RA 5.2).

- **Complex problems:** In this case, the learning outcome should be understood as complex engineering problems. Complex engineering problems include one or more of the following characteristics: involving wide-ranging or conflicting technical issues, having no obvious solution, addressing problems not encompassed by current standards and codes, involving diverse groups of stakeholders, including many component parts or sub-problems, involving multiple disciplines, or having significant consequences in a range of contexts. (RA 5.1)

- **Design:** In engineering programs, the concept of design refers, in any case, to an engineering design. Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert

[1] https://www.abet.org/accreditation/accreditation-criteria/

resources into solutions. Engineering design involves identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making trade-offs, for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability

- **Sustainable Development Goals**: In these degrees, and within the scope of the learning outcomes, special emphasis must be placed on the consideration of aspects related to public health, safety, welfare, and the environment (RA 1.4).

- **Professional practice**: In these degrees, professional training is circumscribed to engineering situations as established in the CIN standards of each program or, failing that, the objectives, competencies, and specific learning outcomes established for each (RA 1.1).

Correlation tables learning results

Those degrees that opt for international accreditation by the EAC-ABET must ensure the adequate acquisition of the competencies established by this commission. To this end, special attention will be paid to the monitoring of the learning outcomes of the UPV cross-curricular competencies framework related to them, which will be reinforced by the specific competencies of the degree itself.

At least one control point for each of the aforementioned learning outcomes must be established in the Curriculum's Course Description, defining rubrics and collecting evidence of the level of achievement of the same by the students. The specific analysis of the evaluation of the acquisition of these learning outcomes will be explicitly included in the annual report of the degree.

As defined in the cross-curricular competencies project UPV, the Bachelor's thesis is also part of the assessment of these learning outcomes. The engineering programs, tutors, and boards will evaluate the students' results in the elaboration and the defense of the Final Project through specific rubrics. In undergraduate degrees, emphasis will be placed on verifying that the work responds to a complete engineering design experience.

The learning outcomes established by the ABET Engineering Accreditation Commission has defined 7 general learning outcomes, which are reflected in/correspond with the following learning outcomes of the UPV framework, all applied to the engineering field.

ABET-EAC STUDENT OUTCOMES	UPV GENERIC STUDENT OUTCOMES
ABET 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	**SO 5.1** Identify, formulate, and solve complex problems autonomously, applying the principles of the discipline.
ABET 2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	**SO 1.4** Design, develop and implement solutions in the field of the discipline that respond to social demands, taking into account the Sustainable Development Goals and global, cultural and economic factors.
ABET 3. an ability to communicate effectively with a range of audiences.	**SO 4.3** Communicate and argue effectively, adapting the organization of content and the use of language, verbal and nonverbal, to different situations and/or a range of audiences.
ABET 4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	**SO 1.1** Recognize ethical consequences of decisions to be taken in a specific situation, considering the impact on society and responsibility in professional practice. **SO 1.2** Make informed judgments considering the impact of solutions, in the field of the discipline, in global, economic, social and environmental contexts.
ABET 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	**SO 3.1** Function effectively on a team whose members together provide leadership and create a collaborative and inclusive environment in the organization and coordination of work. **SO 3.3** Collaborate proactively in the development of work, setting goals and meeting objectives.
ABET 6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	**SO 5.2** Develop and conduct practical or experimental work and research, interpreting data and drawing conclusions based on the principles of the discipline.
ABET 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	**SO 5.3.** Acquire and apply new knowledge as needed, using appropriate learning and time management strategies.

The UPVGSO framework is designed to be applicable to all programs and fields of study at this University, including Engineering, Business, Arts, and others. As a result, it does not specify certain parameters or attributes that are specific to the field of engineering. However, the framework does mention the fields of each discipline where appropriate in the general definition.
The phrase 'principles of the discipline' and 'in the field of the discipline' are used in a general manner.