A Curriculum Proposal for Forestry Engineering Studies at Degree Level According to USAEE[1] Guidelines

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Abstract

The aim of the present work is to draw up a proposal of core subjects for study courses in Forestry and Natural Environment engineering according to the guidelines from the thematic network, Studies of Agricultural Engineering in Europe (USAEE, 2006) and the Ibero-American Association of Institutes of Engineering Education (ASIBEI, 2005), taking into account the objectives of the Bologna declaration and according to the Spanish legal framework about the European Higher Education Area (EHEA). It provides a summary of the USAEE document which, after an overview of Agricultural Engineering studies in Europe, proposed a 3-year (or 180 European Credit Transfer System, ECTS) programme of studies to obtain the degree of Agricultural engineer (or Biological or Biosystems engineer). The curricular guidelines for engineering courses in Latin America drawn up by the Ibero-American Association of Institutes of Engineering Education (ASIBEI, 2005). Based on that information, this work make a proposal of engineering syllabuse Forest and Natural Environments, a courses structure with the same groups of subjects and number of ECTS credits as recommends the USAEE network, and with a structure which is as similar as possible to engineering studies in Latin America.

Introduction

The structural reforms inspired by the Bologna process (1999) constitute an opportunity to reorganize university studies programmes to obtain different titles of degree in AgroForestry and Natural Environment engineering.

A paper of European Commission (2007) starts with the three reform priorities in the Bologna Process and explains the Commission contribution to the realisation of these priorities: quality assurance, the degree system and recognition of degrees and study periods. The

[1] University Studies of Agricultural Engineering in Europe (Thematic Network)

Bologna process is more than half-way, the reforms are in the laws, now reforms have to become a reality for students and teachers in everyday university life.

The degree system - towards a European Qualifications Framework (EQF): Ministers in Bergen (2005) adopted the overarching framework for qualifications in the EHEA, comprising three cycles, generic descriptors for each cycle based on learning outcomes and competences, and credit ranges in the first and second cycles. Both the EQF for LLL (Life Long Learning) and the EQF for the EHEA are formulated in generic terms (knowledge, skills and competences to be achieved at a given level of qualification). In order to become operational, EQFs will need to be translated in both National Qualifications Frameworks (NQF) for Member States and Regions and Sectoral Qualifications Frameworks (SQF) for specific disciplines or areas of professional activity. The Commission supports networking of national frameworks and the development of sectoral frameworks at European level.

In Spain, the successive governments, from year 2003, have enacted legislation regarding EHEA (the first, about European Diplome Supplement[2] at 11/09/2003, and relating to European Credit Transfer System at 18/9/2003); the last published at 30/10/2007 (Royal Decree 1393/2007 of 29 October 2007), establishes organization of official university education according to above guidelines of European Commission.

In this work we will focus on the definition and justification of knowledge and skills needed to training education of professionals in engineering Forestry and Natural Environments, according to the general European guidelines, Spanish current regulations and principal guidelines of European Agroforestry and Environmental frameworks to establish core curricula in engineering studies in Agronomy, Forestry and Environment.

New Challenges for Spanish Universities: Legal framework

To establish the degree system the last Spanish regulation proposes that the teachings degree have as the main objective a general education of the students, in one or more disciplines, aimed at preparing for the performance of activities of a professional nature.

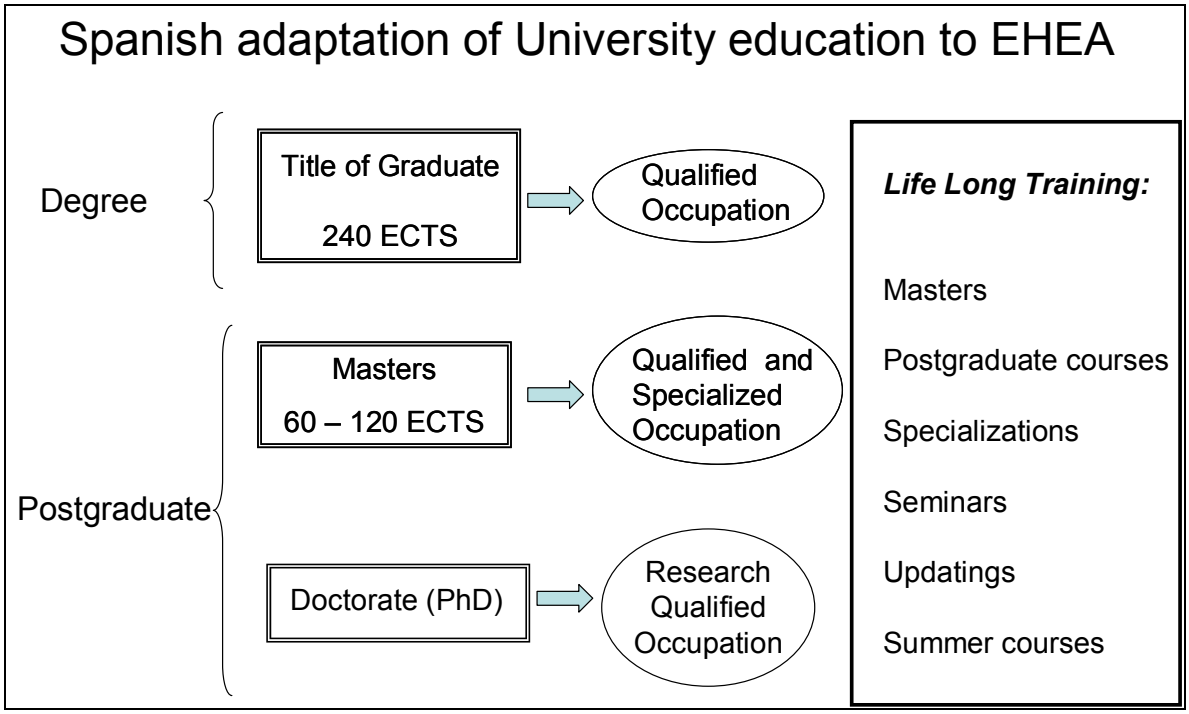
The current regulation also establishes the basis for developing universities curricula: The degree programmes, master and doctorate (PhD) levels of University education will be impart by the Universities to lead the relevant official titles.

According to the Royal Decree 1393/2007 of 29 October 2007, the fulfilment of the objectives set out in the curriculum leading to degrees university will be measured in European credits

[2] The Diploma Supplement is being promoted as part of the single European Framework for Transparency of Qualifications and Competences

(ECTS) and the level of learning achieved by students in official teachings of Degree and Masters Degree, shall be expressed in numerical scores.

The current regulations and for each cycle (Bachelor or Graduate, Master and Doctorate) include a list of the minimum of competences and skills to reach with learning objectives depending on programme degree.



The basic guidelines that Spanish regulations establishes to design degree titles (graduate) are: The studies programmes will have 240 ECTS; they will contain all the theoretical and practical training the student should acquire, such as basic aspects of the branch of knowledge, mandatory or optional subjects, seminars, external practices, work directed, work order Grade or other educational activities. The development and defense of a final-year project will be the end of training of this level.

The University will propose the allocation of the corresponding degree title to any of the following branches of knowledge:

A) Arts and Humanities

B) Science.

C) Health Sciences.

D) Legal and Social Sciences.

E) Engineering and Architecture

For the branch of engineering and architecture, study programme should contain a minimum of 60 credits of basic training, of which at least 36 will be linked to some of the following matters: Graphic Expression, Physics, Informatics, Mathematics, Chemistry, Enterprises.

These matters should be determined in subjects with a minimum of 6 credits each and will be offered in the first half of the studies programme.
The remaining credits to 60, where appropriate, must be configured for core subjects in the same or other branches of knowledge of the above-mentioned. Also it is possible to complete those 60 credits with other matters accounting its basic character for the initial formation of the student or its cross character.
If practices are scheduled outside, they will have a maximum length of 60 credits and should be provided preferably in the second half of the studies programme.
The final-year project will take between 6 and 30 credits, it must be carried out in the final stage of the programme and be oriented to the assessment of skills associated with the title.

Spanish engineering studies and the problematic of adaptation to EHEA

In Spain the qualifications in engineering are divided in two levels which are distinguished by length of studies programmes: “higher technical engineering” (first and second cycles) of a total length of 5 years (in some cases of 6 years), with access to PhD studies, and “technical engineering” (first cycle) of a total length of 3 years, with a more professional approach. The impact of Bologna on this scenario is still uncertain (Cuadra, 2007). So, according to the Bologna process, in year 2003, and because an announcement of the National Agency of Quality Evaluation and Accreditation (ANECA), 30 Spanish university institutions of agronomic and forestry engineering get together to prepare a work with the curricula guidelines for the syllabuses of “Agronomy engineer” and “Forestry and Natural Environment engineer” titles of degree (ANECA, 2005).
In this work, to make a proposal of core subjects for the studies of the Forestry and Natural Environment engineer, we are based on the quoted document from ANECA, the guidelines from the thematic network Studies of Agricultural Engineering in Europe (USAEE, 2006) and the Ibero-American Association of Institutes of Engineering Education (ASIBEI, 2005).

Basis for a Curriculum Proposal for Forestry Engineering and Natural Environment Management

The main objective of the USAEE TN is to establish the core curricula requirements for Agricultural Engineering University studies in Europe (as well as Biosystems and Biological Engineering, or similar titles).
From the point of view of the Forest engineering studies, the SILVA Network, European Academic Network for Forest Sciences and a Standing Committee for Forestry of ICA (Interuniversity Consortium for Agriculture and Related Sciences) has over 40 member

institutions involved in higher forestry education representing most European countries, in co-operation with AFANet - SOCRATES Thematic Network for Agriculture, Forestry, Aquaculture and the Environment and "Improvement of Distance Education in Forestry" (2003). The ultimate aim of SILVA Network is to maintain and improve the high quality, competence and attractiveness of European forestry education in Europe and in a global context.

Moreover, it is interesting to encourage attractiveness and cooperation with other parts of the world. An effective educational network would enhance the attractiveness of European higher education over the other continents. Engineers from Ibero-American countries agreed to promote certification and accreditation in a concerted way, on common basis and approach that allowing to quality assurance and assessment guarantee academic quality of their graduates. In this sense, there are different works and meetings like the project Tuning-Latin America (Gonzalez et al. 2004), Gómez, 2005, ASIBEI journal, 2006,…

Thematic network, USAEE (2006), after an overview of Agricultural Engineering studies in Europe, proposed a 3-year (or 180 European Credit Transfer System, ECTS) programme of studies to obtain the degree of Agricultural engineer (or Biological or Biosystems engineer). The general training course categories include a high percentage of basic and engineering sciences, with the aim of incorporating graduates into the labour market, where they will acquire the necessary specialisation in the workplace. Another degree course is contemplated, also with a duration of 3 years, which would not provide a professional qualification but would qualify the holder to continue to postgraduate level and also facilitate mobility. In this case specialisation would not be acquired in the workplace but in post-graduate university studies. These specialisation modules are also proposed in the USAEE text. The structure of the study programme is shown in Table 1.

Table 1

Subject Groups	*Credits*	*Rates*
Basic subjects	36-45	20-25 %
Basic Engineering Sciences	72-81	40-45 %
Basic AgroForestry Sciences	36-45	20-25 %
Optional subjects	18-27	10-15 %
Total	180	100 %

The curricular guidelines for engineering courses in Latin America drawn up by the Ibero-American Association of Institutes of Engineering Education (ASIBEI, 2005) used information provided by eleven higher education institutions in Latin America (Argentina, Brazil, Colombia, Chile, Mexico, Peru, Uruguay, Venezuela, Portugal and Spain (represented by the Polytechnic University in Madrid). The panorama of Latin American Engineering studies is

very heterogeneous and is structured into subject groups which are similar to those proposed by USAEE (Table 2).

Table 2

Subject Groups	*Rates*	*Average rates*
Basic subjects	17-35	24 %
Basic Engineering Sciences	15-38	27 %
Basic AgroForestry Sciences	15-55	29 %
Optional subjects	0-20	11 %
Total	100%	

Based on the above, this work proposes a course structure with the same subject groups and number of ECTS credits (European Credit Transfer System) as in the USAEE network recommendations, and with a structure which is as similar as possible to engineering studies in Latin America (Table 3).

Table 3

Type	*Subject Groups*	*Credits*	*Rates*
Non- technical	Basic subjects	45	25 %
	Optional subjects	18	10 %
Technical	Basic Engineering Sciences	72	40 %
	Basic AgroForestry Sciences	45	25 %
Total		180	100 %

A Curricular proposal for studies in Engineering Forestry and Natural Environments Management

In this section is presented a study programme of 4 years (240 ECTS), according to Spanish regulation. The following tables (4 to 7) contain subjects and credits for each.

Tabla 4: First course

Subject	**ECTS**	**Subject matter**	**Subject Groups**
Calculus	6	Mathematics	Basic
Algebra	6	Mathematics	Basic
Physics	6	Physics	Basic
Chemistry	6	Chemistry	Basic
Informatics	6	Informatics	Basic
Engineering design and computer graphics	6	Technical	Basic Engineering Sciences
Business Organization	6	Legal and Social Sciences	Basic Engineering Sciences
Thermodynamics	5	Technical	Basic Engineering Sciences
Statics	5	Technical	Basic Engineering Sciences
Optional	8	Humanities	Basic
TOTAL	60		

Table 5: Second course

Subject	ECTS	Subject matter	Subject Groups
Advanced Calculus	6	Mathematics	Basic
Statistics	6	Mathematics	Basic
Dynamics	5	Technical	Basic Engineering Sciences
Fluid Mechanics	5	Technical	Basic Engineering Sciences
Thermotechnics	5	Technical	Basic Engineering Sciences
Electricity and electronics	5	Technical	Basic Engineering Sciences
Edaphology	5	Sciences	Basic AgroForestry Sciences
Meteorology and Climatology	5	Sciences	Basic AgroForestry Sciences
Optionals (at least 2)	10	Technical	Basic Engineering Sciences
Optionals	5	Humanities	Basic
Optional	5	Sciences	Basic AgroForestry Sciences
TOTAL	60		

Table 6: Third course

Subject	ECTS	Subject matter	Subject Groups
Operation Research	4	Mathematics	Basic
Dynamical systems	4	Technical	Basic
Plant Biology	5	Sciences	Basic
Animal Biology	5	Sciences	Basic
Biochemistry	4	Chemistry	Basic
Ecology	5	Sciences	Basic
Optionals (at least 2)	18	Technical	Basic Engineering Sciences
Optionals (at least 2)	15	Sciences	Basic AgroForestry Sciences
TOTAL	60		

Table 7: Fourth course

Subject	ECTS	Subject matter	Subject Groups
Greenhouses and Nurseries	5	Sciences	Basic AgroForestry Sciences
Parks, gardens and urban trees	5	Sciences	Basic AgroForestry Sciences
Landscape	5	Sciences	Basic AgroForestry Sciences
Projects	4	Technical	Basic Engineering Sciences
Territory Planning	4	Technical	Basic Engineering Sciences
Marketing Analysis	4	Technical	Basic Engineering Sciences
Optionals	15	Technical	Basic Engineering Sciences
Optionals	10	Sciences	Basic AgroForestry Sciences
Final-year project	8	After to pass the total of programme subjects	
TOTAL	60		

In this proposal the course units are those that appear in the USAEE work (2006): fundamental core basic Engineering Sciences (44 ECTS) and fundamental core basic Agricultural/ Biological Sciences (25 ECTS).

Two modules or specializations are proposed: Forest Production and Forest Industry with optional subjects in Engineering Sciences (28 ECTS) and Agricultural/ Biological Sciences (20 ECTS), classified according to the above subject groups (see table 8).

Table 8: Subjects of Specialities and Subject groups

Subject Groups	**Speciality**	
	Forest Production	***Forest Industry***
Basic Engineering Sciences	• GeneraTechnology of forest products. • Surveying and GIS. • Remote Sensing. • Forest Exploitation. • Forest Machinery. • Forest tracks. • Hydrology . • Irrigation systems. • Precision Forestry Technology	• Physics of the wood. • General and Industrial Technology. • Surveying and GIS. • Forest Exploitation • Forest and Industrial Machinery. • Forest tracks. • Instrumental Analysis. • Chemistry of non-woody forest products. • Technology non-woody forest products • Timber Technology • Timber Structures • Quality control
Basic AgroForestry Sciences	• Trees Measurement • Silviculture. • Reforestation. • Forest Management and Assessment. • Forest Diseases and Pests. • Forest Fire-Fighting. • Hunting knowledge. • Forest Genetics. • Fishing knowledge. • Grazing knowledge	• Environmental impact assessment. • Forest Diseases and Pests. • Management and treatment of waste. • Environmental Management. • Silviculture and reforestation. • Forest Management and Assessment. • Timber Treatments. • Drinking water and wastewater. • Sanitary Engineering. • Industries of Cork bark, resins and essentials oil.

To sum up the contents of the previous tables, grouping the first three courses (180 ECTS), we have table 9, and the fourth and last course (60 ECTS) with the previous specialization subjects in table 10.

Table 9: First level of the degree title (180 ECTS)

Subject Groups	Subject matter	Subjects	ECTS	Type
Basic	Mathematics (24)	Calculus	5	x
		Advanced Calculus	5	x
		Algebra	5	x
		Statistics	5	x
		Operation Research	4	x
	Physics (8)	Physics	8	x
	Chemistry (8)	Chemistry	4	x
		Biochemistry	4	x
	Informatics (5)	Informatics	5	x
Optionals	Legal and Social Sciences (18)	Economy	5	
		Technical and Financial Management	5	
		Legislation	4	
		Sociology and Ethics	4	
Basic Engineering Sciences	Basic (44)	Engineering design and computer graphics.	5	x
		Statics	5	x
		Materials Strength	5	x
		Dynamics	5	x
		Fluid Mechanics	5	x
		Hydrology	4	x
		Thermodynamics	5	x
		Thermotechnics	5	x
		Electricity and electronics	5	x
		Dynamical systems	4	x
	Optionals (28) Forest Industry	Physics of wood	5	
		General and Industrial Technology	4	
		Surveying and GIS	5	
		Forest Exploitation	5	
		Forest and Industrial Machinery	4	
		Forests tracks	4	
		Business Organization	5	
		Instrumental Analysis	5	
		Chemistry of non-woody forest products	5	
	Optionals (28) Forest Production	GeneraTechnology of forest products	5	
		Surveying and GIS	5	
		Remote Sensing	4	
		Business Organization	5	
		Forest Exploitation	5	
		Forest Machinery	4	
		Forests tracks	4	
Basic AgroForestry Sciences	Basic (25)	Plant Biology	5	
		Animal Biology	5	
		Edaphology	5	
		Meteorology and Climatology	5	
		Ecology	5	
	Optionals (20) Forest Industry	Environmental impact assessment	4	
		Forest Diseases and Pests	4	
		Management and treatment of waste.	4	
		Environmental Management	4	
		Silviculture and reforestation.	4	
		Forest Management and Assessment	4	
	Optionals (20) Forest Production.	Trees Measurement	4	
		Silviculture.	4	
		Reforestation	4	
		Forest Management and Assessment	4	
		Forest Diseases and Pests	4	
		Forest Fire-Fighting	4	

Table 10: Second level with specialization subjects (60 ECTS)

Subject Groups	Subject matter	Subjects	ECTS	Type
Basic Engineering Sciences	Basic (20)	Projects	4	
		Territory Planning	4	
		Marketing Analysis	4	
	Optionals (15) Forest Industry	Technology non-woody forest products	5	
		Timber Technology	5	
		Timber Structures	5	
		Quality Control	5	
	Optionals (15) Forest Production	Hydrogeology	5	
		Irrigation Systems	5	
		Precision Forestry Technology	5	
Basic AgroForestry Sciences	Basic (15)	Greenhouses and Nurseries	5	
		Parks, gardens and urban trees	5	
		Landscape planning	5	
		Ecotourism	5	
	Optionals (10) Forest Industry	Timber Treatments.	5	
		Drinking water and wastewater.	5	
		Sanitary Engineering.	5	
		Industries of Cork bark, resins and essentials oil.	5	
	Optionals (10) Forest Production	Hunting knowledge.	5	
		Forest Genetics.	5	
		Fishing knowledge.	5	
		Grazing knowledge	5	
Final-year project			8	x

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