Towards the harmonisation of Electrical and Information Engineering Education in Europe

August 2003

Based on the results of the EU-funded thematic network THEIERE:

Thematic **H**armonisation in **E**lectrical and **I**nformation **E**ngineer**R**ing in **E**urope

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Contents

Presentation

This report has been written during the academic years 2001-02 and 2002-03 by a partnership composed of the 87 universities belonging to the THEIERE (Thematic Harmonisation in Electrical and Information EngineeRing in Europe http://www.eaeeie.org/theiere/) Thematic Network, with the co-operation of the EAEEIE (European Association for Education in Electrical and Information Engineering, http://www.eaeeie.org) and Club EEA (http://www.clubeea.org), in particular, the members of the Commission for academic affairs and the Commission for international relationships of this society.

It should be noted that the Ph. D./Doctorate level is not taken into account in the present monograph.

This monograph has been published in the summer 2003, and takes into account the situation at this time. For following years, it will continue to be useful thanks to the fact that the evolution process is quite slow. It is hoped that update or new editions of the study will be published in the future, under the aegis of the EAEEIE.

Every effort has been made to make the contents of the present monograph accurate but apologies are given for any accidental errors or omissions. In order to correct any new release of the monograph, please contact:

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An introduction from the President of the EAEEIE,

During its history the EAEEIE has participated in several European Union programmes and projects. The Socrates programme was intended to promote student exchange within the Union. The late Professor Jean Peperstraete of Universiteit Leuven (Belgium) was very active in the implementation of the program with good results. Later the INEIT-MUCON Thematic Network project was proposed by the EAEEIE to create web-based learning material in Electrical and Information Engineering. The past Secretary General of the EAEEIE, Professor Michel Robert of Université Henri Poincaré Nancy 1 (France) made a major contribution to the success of the project. Results of the project have been reported in several conferences, and journals as well. The results are available to the interested parties from the EAEEIE web pages.

During the last several years the EAEEIE has been working on the harmonization of the curricula Europe-wide. Professor Maria João Martins of Instituto Superior Técnico, Lisboa (Portugal), proposed a new Thematic Network, THEIERE to be established for the analysis of the educational situation in Europe. THEIERE members have provided descriptions of the structures of the higher engineering education in their countries. This has required a lot of work due to the rich variety of systems even within each country. It can be concluded that Europe has a long way to go before a clear, easily understood, Pan-European educational system can be established. The THEIERE project has made an attempt at understanding the problems involved and has created expertise within the participating members which will be useful in the future during the implementation of the Bologna process.

On behalf of the European Association for Education in Electrical and Information Engineering I thank all the participants of the THEIERE Thematic Network project for their contribution.

Pentti LAPPALAINEN
President of the EAEEIE, 2000-2003

An introduction from the President of the Club EEA,

Harmonization of studies in the European Union has been a major task of the French Club EEA Association (http://www.clubeea.org) over the last four years. This association gathers more than 1000 teachers and researchers working in the field of electrical engineering, including electronics, microelectronics, optoelectronics, automation control, instrumentations, image processing, computer engineering, power electronics and systems, energy production, etc... The association has proved its efficiency and has been recognized by French Ministries of Education and Research and Research institutions such as CNRS, and is considered as a preferential interlocutor in this generic field.

The academic and international relationship chapters of this association, which both composed of more than 40 regular attendants on average, considered, after the Bologna Meeting, that this harmonization could be a good opportunity to reflect upon and therefore renew, the studies in electrical and information engineering in France. In the frame of the four-year contract of the French Institutions with the French Ministry, these chapters proposed an adaptation to Bologna's Bachelor, Master, Doctorate (BMD, called EEES or 3-5-8 model in France), to include European Credits Transfer System and to adapt the new curricula to the strong evolution of the Information and Communications Technology and Sciences.

The Club EEA was at the origin of the founding of EAEEIE Association at the end of the 80s and of course has maintained strong connections with it. A significant involvement in the INEIT-MUCON and THEIERE European Thematic Network projects of the members of Club EEA association enhanced the activities of these European networks, in order to develop new pedagogical tools, especially, internet based multimedia and interactive resources. Following the Bologna process, a reflection was also launched and led to the set-up of a database related to all the European countries education systems with the goal of "Harmonisation of Electrical and Information Engineering Education in Europe" which is the title of this book. Numerous Club EEA members contributed to the writing of it.

As President of the Club EEA over the last four years, and on behalf of this Association, I acknowledge the contribution of all the members that took part in the resulting synthesis. These colleagues always worked in addition to their usual activities, that is a sign of the interest they demonstrate for both education and European dimension.

Professor Olivier BONNAUD
President of Club EEA Association 1999-2003

The European Higher Education Area and the future of Engineering Education

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1. Introduction

The construction of the European Higher Education Area (EHEA) until 2010 is the aim of the Declaration signed by the Ministers responsible for Higher Education in Bologna in June 1999 [1]. This declaration is at the origin of the Bologna Process that has been active since then. The objectives set out in Bologna were revised in Prague in May 2001 [2] and in Berlin in September 2003 [3].

The great challenge of the Bologna Process is to give way to a diverse, yet organised, EHEA. Such an objective requires the active involvement of different actors, namely of Governments and Higher Education Institutions. The numerous initiatives, seminars, conferences and projects, that have been taking place since the Bologna Conference, are progressively shaping the EHEA.

Different subject areas have diverse requirements, as is the case of Engineering. This means that, under a common framework, specific subject characteristics have to be accounted for. This was already realised during the first two years of the process and was raised in the report to the Ministers presented in Prague [4].

2. The objectives

The main objectives of the Process include making the EHEA competitive and attractive world-wide and an area where mobility and employability is achieved through a number of instrumental objectives. Life-long learning and social dimensions were added to the main objectives at the Ministers' meeting in Prague.

The instrumental objectives comprise the establishment of comparable degrees, organised in two main cycles, the use of compatible credits systems, such as ECTS, and of the Diploma Supplement. Quality assurance, the overcoming of obstacles to mobility, the development of European dimensions, as in joint degrees, the recognition of qualifications and information are also among the instrumental objectives. The establishment of frameworks of qualifications, both at national and European level, was also included.

In Berlin, the Ministers decided to establish intermediate concrete targets for 2005 [3]:

- To have started the implementation of the two cycle system;
- To issue on a regular basis the Diploma Supplements to graduates;
- To ensure that national quality assurance systems include a minimum of common features.

3. The degree structures

A general agreement on the degree structures has been reached during the process. First degrees should require 180 to 240 credits (equivalent to 3 to 4 years fulltime) [2,5] and the Masters should require 90 to 120 credits after the first degree [6], with a minimum of 60 credits at Master level. Long one-tier programmes, leading directly to Master's level, may continue to exist, in subject areas were it is justifiable, although intermediate degrees are desirable.

Masters degrees may different orientations and various profiles, meaning that they may be of a scientific or professional nature and structured accordingly.

4. Frameworks of qualifications

A common framework of qualifications was included, as an objective of the process, at the Prague Ministerial Conference [2]. In Berlin, the Ministers encouraged the member States to elaborate a framework of comparable and compatible qualifications for their national higher education systems. These frameworks should describe qualifications in terms of workload (the ECTS credits), level, learning outcomes, competences and profile. This approach is referred in several of the official Bologna seminars held between Prague and Berlin and was the specific focus of a seminar held in Copenhagen in March 2003 [7,8].
The use of learning outcomes, as a common language to define the programmes, is gaining ground. Expressing the these outcomes in terms of knowledge, competences and skills, agreed at European level for each subject area, will enhance readability of qualifications by employers, society at large and academic institutions, the recognition of qualifications and the accreditation of learning obtained in different contexts. It also contributes to make the learner, the student, the centre of the educational process.
There are a number of initiatives that aim at classifying and explain qualifications and qualification frameworks, such as [7]:

- Ba-Ma generic descriptors, e.g. JQI Dublin descriptors [9];
- Ba-Ma subject-specific benchmarks, e.g. Tuning Project [10];
- Integrated national frameworks, e.g. Ireland, Denmark and Scotland;
- Learning outcomes and competences – generic and specific, e.g. UK and Denmark.

5. Two paradigms of the EHEA

The emphasis on the learning outcomes, rather than on syllabus, transfers the focus from teaching to learning, making the educational process a learner centred one. This is a paradigm that is being reinforced as the Bologna Process develops.
The other paradigm is that of an organised diversity. On the one hand, organisation in terms of degrees or qualifications structures is required in the building of an EHEA. But, on the other hand, this organisation should leave room for diversity that is a characteristic and a richness of the European reality.
The term harmonisation has been avoided in the wording of the Bologna Declaration and was one of the reasons that lead to the refusal of a number of EU members refusing to sign the Sorbonne Declaration (signed by France, Italy, Germany and the UK in 1998), as it has a precise meaning in the EU Treaties: making something equal, uniform, in all countries.

6. The engineering education

The engineering profession is generally organised in two different professional levels, corresponding to two types of educational programmes (in particular in continental Europe). The shorter programmes, typically of three years fulltime, more applications oriented, and longer programmes, typically of five years duration, with a stronger emphasis on scientific matters.

Whether these programmes are organised sequentially or with alternative routes, the important issue is the set of outcomes, in terms of knowledge, competences and skills, they lead to, that must be directly related to the type of professional to be educated. Wherever the engineering profession is a regulated one, the access to the profession may be obtained through professionally accredited programmes and/or require professional experience as part of the education and training process.
The organisation of engineering education, in relation to the Bologna Process, has been the object of several initiatives. In February 2003, a joint initiative of CESAER [11] and SEFI [12] led to a number of recommendations [13]. These include that scientifically oriented programmes should lead to the level of the second degree, that an integrated route to the Master level should continue to exist and that specific qualities of application-oriented first cycle degrees must be recognised, with bridges to second cycle programmes being provided. But also, that criteria for degrees in engineering should be based on learning outcomes and competences.
The building of the EHEA does not require that all subject areas have an identical organisation within the common degree structure, but rather that there is a common European understanding of the relevant profiles and learning outcomes within each subject area. Therefore emphasising the importance of a joint work of engineering education schools and professional associations across Europe to reach an agreement on profiles and learning outcomes.

7. The engineering degrees

The application-oriented programmes, aiming at the first level of the engineering profession, should, therefore, lead to a first degree (usually referred in English as Bachelor). The option for sequential programmes, aiming at the second level of engineering and leading to a (professional) Master's degree, should exist. However, longer programmes, leading directly to the Master's degree, may also to be considered.
There are, however, other possibilities, such as a first degree (Bachelor) leading to a broad engineering education, scientifically oriented, that does not confer immediate access to the profession, but that is conceived as an intermediate degree, facilitating the mobility of students. This may be the adequate option for those higher education institutions that do not have a tradition and expertise to provide application-oriented programmes.
Building on this intermediate degree, there may be the option to complete a professional Master's degree, aiming at the second level engineering profession, or a scientific Master's, leading to research.
There is, however, a need to balance the offer of different educational routes, including application-oriented and scientifically oriented programmes, in order to respond to students and society demands.

8. A framework for the engineering education

In conclusion, to build the EHEA in what the engineering education is concerned, the important issue is an agreement, involving the engineering higher education institutions, the professional bodies or associations and the Governments, about the relevant types of programmes and corresponding outcomes, so that the objectives of mobility, employability and recognition of degrees can be achieved at European level.

In figure 1, below, a number of alternative educational routes are depicted. It is based on three different profiles, including the two mentioned above as application-oriented (I. Eng.) and scientifically oriented (C. Eng.), that aim at educating professionals for the engineering professions, but also a profile of Engineering scientist (Eng. Sc.) with a stronger theoretical emphasis, aiming at research.
An intermediate first degree was also considered, as a mobility degree that may lead to a professional Master degree or a scientific one and, through professional practice, may also lead to a professional status equivalent to that of the holders of a professional Master.

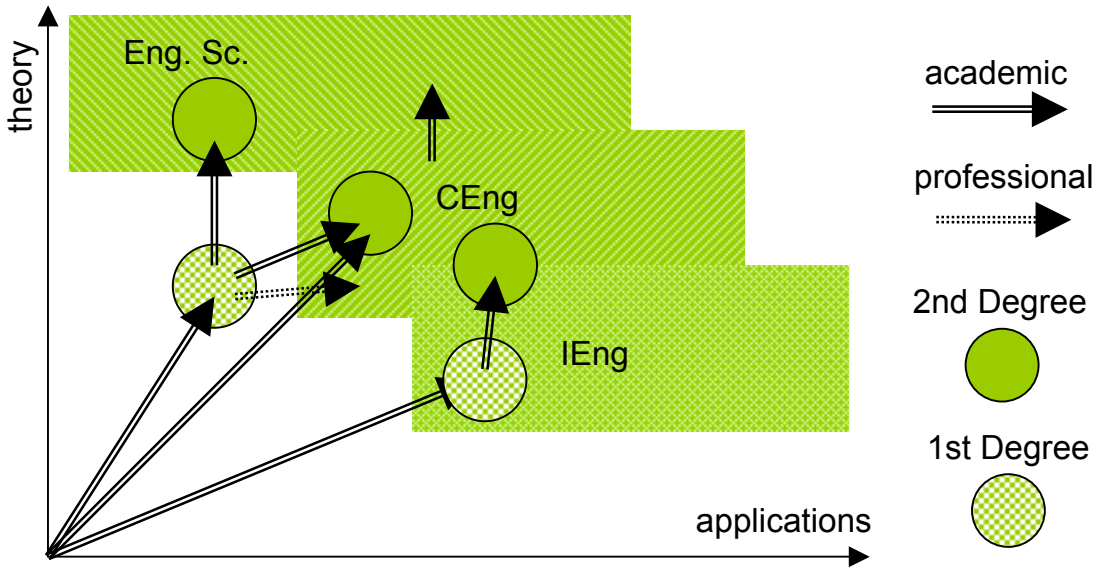

Figure 1

References

[1] Joint declaration of the European Ministers of Education convened in Bologna on the 19th of June 1999.
[2] Towards the European Higher Education Area: Communiqué of the meeting of European Ministers in charge of Higher Education in Prague on May 19th 2001.
[3] Realising the European Higher Education Area: Communiqué of the Conference of Ministers responsible for Higher Education in Berlin on 19 September 2003.
[4] Lourtie, Pedro, Furthering the Bologna Process, Report to the Ministers of Education of the signatory countries, Prague, May 2001.
[5] Conclusions and Recommendations of the International Seminar on Bachelor-Level Degrees, Helsinki, February 2001.
[6] Conclusions and Recommendations of the Conference on Master-Level Degrees, Helsinki, March 2003.
[7] Stephen Adam, Qualification Structures in European Higher Education, Danish Bologna Seminar 27-28th March 2003.
[8] Recommendations of the Conference on Qualification Structures in European Higher Education, Copenhagen, March 2003.
[9] Joint Quality Initiative, http://www.jointquality.com.
[10] Tuning Educational Structures in Europe, http://www.relint.deusto.es/TUNINGProject/index.htm.
[11] Conference of European Schools for Advanced Engineering Education and Research.
[12] Société Européenne pour la Formation des Ingénieurs.
[13] CESAER & SEFI on the Bologna Declaration, Communication of CESAER and SEFI on the Bologna Declaration, based on the joint seminar organised at Helsinki University of Technology, February 2003.

1st part

Presentation, generalities

1. Towards the Bologna-BMD[1] model: A thematic Network contribution to harmonisation of curricula

(extracted from [2, 3, 4])

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1.1. Introduction

The UNESCO declaration on education stresses innovation, interdisciplinarity, transdisciplinarity, co-operation with the labour market and adoption of quality standards as key points in the evolution of educational processes. The European Union is also involved in reflections (Bologna, La Sorbonne, Prague, Berlin conferences,…) in creating the European higher education for the future.

New forms of practice must be devised to prepare students to compete in an open market where information and communication technologies are key features. Due to a fast evolving professional market, Life Long Learning and Continuing Education became a necessity[5].

The association of teachers and researchers in wide networks where exchange of practices and information can take place is an essential step towards better engineering teaching practice and curricula harmonisation.

The THEIERE *(Thematic Harmonisation in Electrical and Information EngineeRing in Europe, http://www.eaeeie.org/theiere)* Thematic Network began in 2000 as the result of converging interests between the EAEEIE (*European Association for Education in Electrical and Information Engineering, http://www.eaeeie.org*), a European association which aims at promoting better engineering practices and develop common curricula in EIE, and the European Commission, through DG Education and Culture which started the Thematic Networks programme in 1996.

1.2. The THEIERE Project

The consortium responsible for this project is composed by:

- 86 European universities
- University of Tangiers, Morocco,

[1] In the following, we refer to "Bologna-BMD" (Bachelor, Master, Doctorate) in order to characterise the process running in Europe as a result of the decisions from the European Commission. Other expressions are sometimes used but less clear: 358 (is not clear because the process is not exactly a 358), and BMD (because BMD alone may refer to the system used in Anglo-Saxon countries or elsewhere).

[2] M. J. MARTINS, M. ROBERT, J.M. THIRIET, J. ESTEVES, "Towards the 3-5-8 model: a thematic network contribution to harmonisation of curricula" - 13th annual EAEEIE Conference, York, United Kingdom, 8-10 April 2002, 5 pages (electronic format), ISBN 1-85911-009-6.

[3] J.M. THIRIET, G. ZISSIS, M. ROBERT, M. J. MARTINS, H. YAHOUI, "Some considerations on the actual implementation of the 358 scheme in Europe" - 13th annual EAEEIE Conference, York, United Kingdom, 8-10 April 2002, 5 pages (electronic format), ISBN 1-85911-009-6.

[4] J.M. THIRIET, P. GEND, M. ROBERT, M. J. MARTINS, C. LLANES - "A tool to help students and colleagues understanding European Higher education systems and diploma in EIE - 14th annual EAEEIE Conference, Gdansk, Polska, 16-18 June 2003, 6 pages (electronic format).

[5] European Commission, "White paper: teaching and learning: towards the learning society", Brussels, November 1995.

- 1 European Association EAEEIE,
- an enterprise Giunti Interactive Labs S.r.l from Genoa, Italy.

The aims of this Thematic Network (TN) project are:

- to survey the available curricula in EIE (Electrical and Information Engineering) throughout Europe,
- to enable curricula comparisons that will facilitate the transfer of knowledge between higher education institutions,
- to reflect on the best practices of higher engineering education in the specific field of Electrical and Information Engineering from a European perspective,
- to develop modules of curriculum and pedagogical tools available through the Internet as pre-requisites to help students for mobility exchange programmes.

The main objective is the co-operation between the several partner institutions in order to contribute to the harmonisation of curricula at a European level, with the inclusion of a large number of eastern European universities and also some observers: Bogazici University in Istanbul (Turkey), University of Mariupol (Ukraine), and University Abdelmalek Saadi from Tangiers (Morocco).

1.3. Partners activities

The partners' activities in THEIERE TN, were divided into two tasks:

TASK 1: A survey and analysis of EIE education at a European level, concerning organisation, pedagogical issues, new pedagogical tools, and main trends in education systems in EIE. For that, it consisted in:

- designing a questionnaire for each of the three levels of study contemplated in the Bologna-BMD Model, to allow an efficient survey of European Curricula,
- summarising the results obtained in graphical form to facilitate the apprehension of the educational structures in Europe.

TASK 2: Development of course modules available through the Internet, which are available at the THEIERE web-site, for the general public. These modules continue the work performed in our previous thematic network INEIT-MUCON, and represent a continuous effort to build a European virtual university in EIE, with an agreed syllabus that comes from the contribution of the representatives of the participating institutions in this network. This aspect is not further developed in this monograph. The results of the THEIERE project can be found in http://www.eaeeie.org/theiere/pedagogical_resources.html.

1.4. Description of the activities of the "task 1"

Within the THEIERE project, a group has been set in order to work on the implementation of Bologna-BMD scheme in Electrical and Information Engineering. During the first academic year of the project an analysis was undertaken of academic systems of the various European countries, which is available from the website of the project (http://www.eaeeie.org/theiere). This analysis gave a certain view of the European academic systems.

Building on the results of this study, subsequent activities of the project focused on:

- trying to propose some limits or boundaries to the discipline field of Electrical and Information Engineering; are these limits the same in the various European countries?
- trying to have a view on the various diploma specialities proposed throughout Europe, in the various levels of academic studies,
- making a census of the availability of the various diplomas proposed in European universities or high schools.

1.5. Present situation of the Bologna-BMD implementation

A first overview of the present implementation of the Bologna-BMD scheme in the various countries was completed by the end of 2001, to show the current situation.

From this overview, a first synthesis has been achieved (see chapter 3 of this monograph).

The data shows that the situation varies considerably from one country to another. In general, the encouragement to implement the scheme has come directly from the state.

1.6. Discussion

Recognition of programmes of study takes place at a number of different levels:

- recognition by industry (discussions with professional bodies, differences between classical universities and "engineering schools/*écoles d'ingénieurs*"),
- national recognition and accreditation,
- European recognition.

At the time of the study, the recognition or accreditation of qualifications was done on a national basis. Thus universities who wished to give their students a better mobility capability had to organise a bi-lateral agreement with another foreign university, with the possibility, for the best cases, for the students to get both two qualifications (which implied also that the choice was limited to these two partner-universities). Another possibility, proposed by the European Commission, consisted of credits as ECTS (European Credit Transfer System) or European Credit Accumulation System for Lifelong Learning, giving an "international coloration" for a national qualification.

One of the aims of the present study is to evaluate the limiting factors to proposing a framework for the organisation of a diploma in the EIE disciplines which can be implemented throughout Europe.

1.7. Aim of the working group

Within the THEIERE project in co-operation with National organisations such as the Club EEA[6], the aims of the work were the following:

- to help each university to implement its own curricula by providing a European common format of the Bologna-BMD system. It is not planned to propose a common course scheme because this is particular to each university and depends on their local social and industrial environment. The aim is just to make a proposal to give a common definition of the different diploma present in the Bologna-BMD system (label, duration, number of credits, school schedule, examination …),
- to think of the best way to implement the Bologna-BMD scheme, with a European view (student mobility, recognition of degree),
- to reflect on what is the interest to keep some curricula/degree outside the Bologna-BMD scheme?
- to build on the work done during the INEIT-MUCON project ("the minimum as an engineer has to know")[7] in relation to:
  - emerging disciplines,
  - new pedagogy,
  - indispensable fundamentals,
  - evaluation methods,
- to compare what EIE means in the various countries (curricula in EIE, curricula in which EIE is a part).

In order to achieve the project aims, the following work was planned for the second year of the project:

- establish a list of universities per country in which there is "Electrical and Information Engineering",
- make a census of the kinds of curricula, number of students (to show the "weight" of EIE studies in Europe),
- analyse the contents of these curricula and the accreditation processes (which programmes are defined at the national, or regional, levels by some commissions and what is the present state of the implementation of the Bologna-BMD scheme),
- establish relationships with organisations at the national levels (to have in each country a working group to help in the work),
- establish relationships with other broader European organisations (EAIE European Association for International Education, French-Dutch Universities Network, SEFI,...).

Some national workgroups have been set in order to get information for the various countries.

[6] B. DE FORNEL, J. M. THIRIET, O. BONNAUD - "The French Club EEA Commission for International relationships" - 12th annual EAEEIE Conference, Nancy, France, 14-16 May 2001, pp. 7-10. www.clubeea.org

[7] J.M. THIRIET, M. ROBERT, P. LAPPALAINEN, M. HOFFMANN, M. J. MARTINS, A. SEOANE - Toward a pan-European virtual university in Electrical and Information Engineering - IEEE trans. on Education, May 2002, Vol.45, n. 2, pp.152-160.

1.8. Development of an internet-based tool or website

As a complement to the present monograph, it has been decided to propose an-internet based-tool for colleagues who wish to have a better understanding of the structures and curricula available in Europe and for the students who may be interested in taking some semesters or even a full degree abroad.

This tool reflects the project deliberations on the Bologna-BMD (bachelor-master-doctorate) scheme.

It has been proposed to characterise the various diploma/curricula by a set of keywords.

Each curriculum is described by:

- 5 to 7 keywords to characterise specialities in EIE, accompanied with percentages, linked to the time necessary to work on that field (module) within the curriculum or linked with the number of credits assigned to that module (Example for a bachelor in Telecommunication and Network: Electronics 15 %, Informatics/Computer 15 %, Telecommunications 12,5 %, Networks 12,5 %),
- 3 to 5 keywords characterising some general elements or behavioural skills[8] (Example for a bachelor in Telecommunication and Network: English 7 %, Expression-communication 7 %, Projects 17 %, industrial training period 14 %).

These sets of disciplines/keywords help to elaborate a common glossary. It is the core of the search engine. Associated percentages give more effective results.

Examples of the information available from the webtool are given in figures 1.1, 1.2 and 1.3.

Fig 1.1 Research of degrees in Spain, in the region of Madrid ("*Comunidad de Madrid*")

[8] A. E. WARD - Passport to the ICT Industry - a PanICT project output - 13th EAEEIE conference, York, April 2002

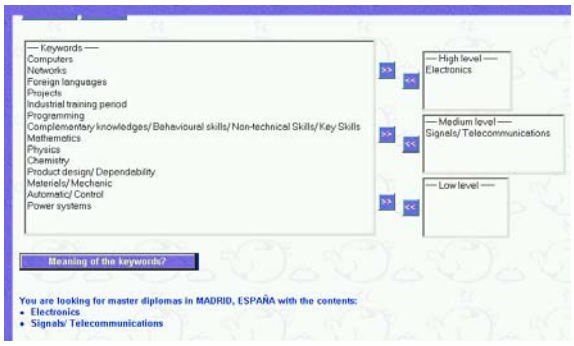

Fig 1.2 Research of masters in electronics, in this region

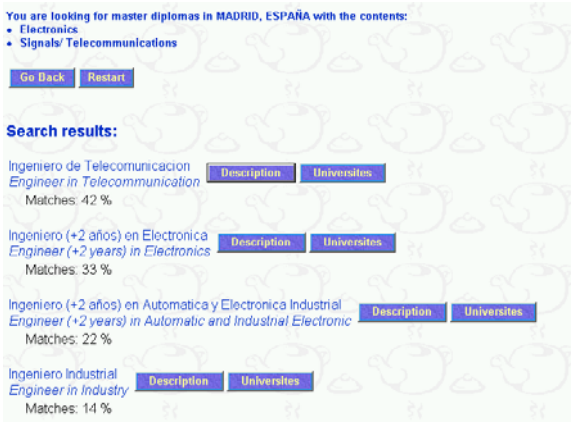

Fig 1.3 List of available masters, in the same region

1.9. Present European scheme in Electrical and Information Engineering

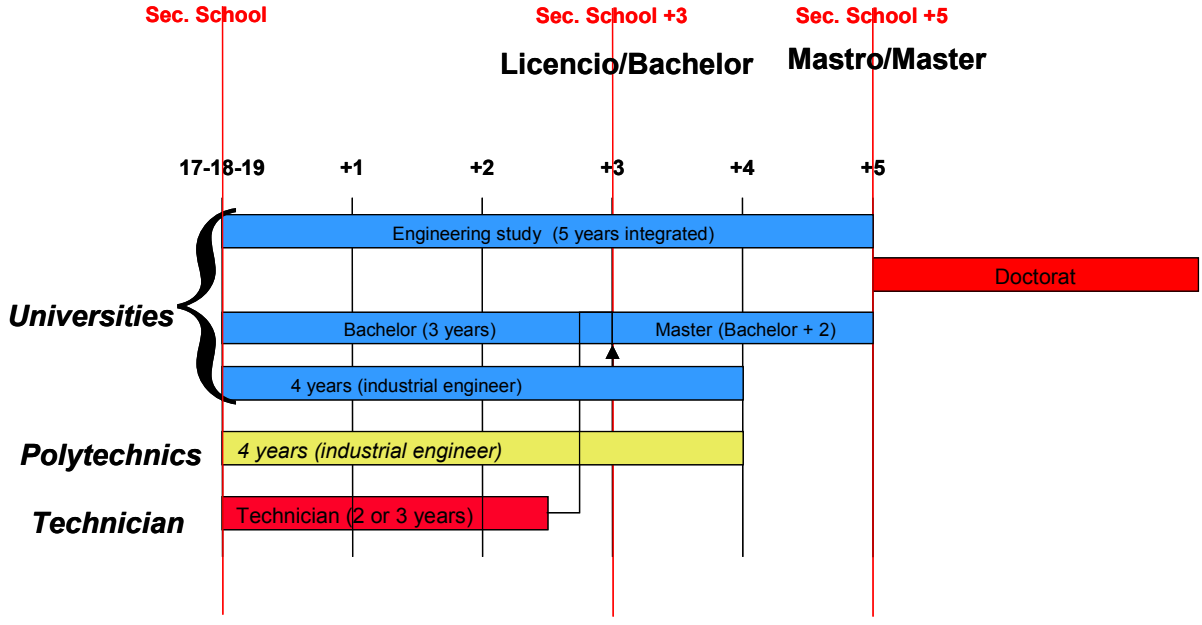

Figure 1.4: European scheme in Electrical and Information Engineering

1.9.1 At the structural level

Figure 1.4 gives a broad overwiew of the structures of EIE education programmes in Europe. As can be seen, there are three main kinds of HE (higher education) structures in Europe:

- universities which have the capability to deliver bachelor, master (*"industrial-oriented"*, included *"engineer school diploma"*, or *"research-oriented master"*) and doctorate qualifications. Most teachers are researchers also,
- polytechnics which have the abilities to deliver industrial-oriented bachelors, or "industrial engineer degrees", connected with industry, generally not connected with research.
- Institutions for technician[9] training, which can be managed inside or outside the university system.

This basic scheme is used for the internet-based tool.

1.9.2 At the degree/diploma level

This is the state of degrees existing in the fields of Electrical and Information Engineering in Europe, in 2003.

1.9.2.1 Sub-degree level (2 years after secondary school (SS)) programmes

In some countries, there are *superior* technician level programmes (2 years after SS). Normally students following these studies go in industry when they graduate, but some follow their studies in the 2nd or 3rd year of bachelor degrees, depending on the possible gateways between different programmes of study.

1.9.2.2 Bachelor degrees (3 y. after SS)

Two kinds of bachelor degrees exist in Europe. Some are "practically-oriented", and normally students go to industry when they graduate. It is nevertheless possible in some cases to follow in a master.

The other kind of bachelor is "theoretically-oriented". It could be possibly part of an integrated, or five-year, master degree, or be independent. This kind of bachelor degree is not recognised as a professional degree, and students should normally follow their studies in a master degree.

1.9.2.3 Intermediate degrees (4 y. after SS)

This kind of degree exist in several countries throughout Europe. This concerns some HE institutions (*Fachhochschule* (DE), *Hogeskole* (BE), *Hautes Ecoles* (BE), *ammattikorkeakoulu* (FI)) generally known with the generic terms of "Polytechnics", "University of applied science" or "Universities of professional education". These institutions are able to deliver neither the master degree nor the doctorate/Ph. D. level degree.

The title could be Engineer (*Ing. FH* (DE), *ingénieur-maître* (FR), *ingénieur industriel* (BE)…). The level is lower than an engineer/master level, and these students normally go to industry when they graduate. Although this degree is professionally-oriented, in some cases, these students can continue on to a master's programme (French *DESS*, after a *maîtrise-IUP (ingénieur-maître)*, for example).

[9] Technician: throughout this study, we refer to the term "**technician**" for "**superior technician**", i.e. technician at an academic level, after the end of secondary school.

1.9.2.4 Master/Engineer degrees (5 y. after SS)

The structures of the master degree could be various:

- one year after an intermediate degree (for example *DESS* after *ingénieur-maître* in France),
- two years after a bachelor degree, conforming with the Bologna process,
- three years in the French "monolithic" system after two years of "*classe préparatoire aux grandes écoles*",
- five years of an integrated, or *ab initio*, master.

The title of Engineer has several different meanings in the various European countries (from technician to master/engineer). The title of engineer at the master level is normally given by a specific commission composed of academic staff and people coming from industry. It is either awarded to a specific degree or directly to selected students[10].

The use and recognition of the title of Engineer is also confused in some coutries. By way of example, in the UK the professional body that oversees the EIE profession, the IEE (Institution of Electrical Engineers), recognizes two different types of engineers. There is the 'Incorporated' engineer and the 'Chartered' engineer. The Chartered engineer requires a Master of Engineering degree (4 years ab initio) from an accredited University whereas the 'Incorporated' engineer typically requires a Bachelor degree. In industry the use of these two types of engineer is blurred but has its routes in the differences between skills of the craft or applied degrees of the old UK polytechnic institutions to the professional engineers of the old university institutions.

Two kinds of master can be envisaged:

- "industrial", or "professional" master for people who want to work in industry, the title of engineer is generally associated with this type of master,
- "research" master which gives the possibility to work in industry (research and development) but which aims mainly to prepare people before entering in a PhD degree.

1.9.2.5 Doctorate/Ph. D. degrees (8 y. after SS)

This degree has not been considered in the present monograph, and will be analysed in future studies.

1.10. Conclusion

The discussion on the implementation of the Bologna process in Electrical and Information Engineering is on the way within the frame of the project. The main results are the publication of this monograph and of a website together with a search engine (http://www.eaeeie.org/theiereyp/). At the present stage of the study, the Ph.D. level has not been considered.

[10] France: *Commission des Titres de l'Ingénieur (CTI)*
Ireland: Accreditation by the *Institute of Engineer*
Portugal: *Ordem dos Engenheiros*

2. Electrical and Information Engineering: outline of a disciplinary field

This part aims to try to find the best words to characterise the academic fields, within Electrical and Information Engineering. The first part considers the names used in English speaking countries worldwide. The second surveys on the vocabulary used in the various European countries.

Initially it is necessary to determine the general usage of the term "Electrical and Information Engineering", which is also part of the name of our association (EAEEIE http://www.eaeeie.org). It appears that several terms are more or less synonyms and in order to have an idea of the pertinence of these terms, a search on a research engine through the internet has been done to get some results. In certains cases, pages are counted when they contain all the words, even if they are not grouped as a complete sentence.

A research on the main used acronyms (ICT, EIE, ITEC, EECS) has been done also in order to give an idea of the various meanings of some acronyms.

2.1. The situation in English speaking countries worlswide

Complete name	Number of occur-rences	Abbreviation	Number of occur-rences	Comments
Information and Communication Technology	305 000	ICT	1 210 000	Some other meanings of ICT: Integrated Circuit Technology, Institute of Computer Technology, Institute for Counter Terrorism, Institute for Chemical Technology…
Electrical and Information Engineering	247 000	EIE	47400	Some comments on "Electrical and Information Engineering: "School of Electrical and Information Engineering" in South Australia University and also others, common with the list above. Other sentences such as "Electrical Engineering and Computer Science" in Chicago, "Electrical engineering, Electronics engineering, information and communication engineering" in Tokyo. Some other meanings of EIE: "European Industrial Engineering", "Ecole Internationale des Entrepreneurs", there is also an "Electrical and Information Engineering Foundation" in the University of Sydney (Australia), the English TV programme "Eight Is Enough", "Eisendrath International Exchange", "School of Electrical and Information Engineering, University of the Witwatersrand, Johannesburg ".
Information Technology, Electronics and Communication	155 000	ITEC	142 000	Some other meanings of ITEC: "International Training and Education Conference", "Information Technology Education Centre", "International Tuba and Euphonium Conference", "International Therapy Examination Council", "Institute for Tropical Ecology and Conservation" …
Electrical Engineering and Computer Science	1 050 000	EECS	414 000	EECS gives 414 000 entries, for the equivalent departments of the U.S. universities, mainly.

2.2. The situation throughout Europe

Country	Names in national languages	Translation in English and explanations
AT: Österreich (Austria)	*Elektrotechnik und Informationstechnik*	Electrical Engineering and Information Technology
BE: België/ Belgique/ Belgien (Belgium)	*Elektronica en informatica*	Electrical and information engineering
	Elektronica en ICT (Information and Communication Technology)	Electronics and ICT
BG: България (Bulgaria)	*Информационни /Компютърни/ науки и технологии*	Information (Computer) Sciences and technologies
	Комуникационни технологии	Communication technologies
	Електроинженерство	Electroengineering
CZ: Česká republika (Czech Rep.)	*Elektrotechnika a informatika*	Electrical Engineering and Computer Science or Electrical Engineering and Informatics
	Elektrotechnika a informační technologie	Electrical Engineering and Information Technology
DE: Deutschland (Germany)	*Elektrotechnik und Informationstechnik (ETIT)*	Electrical Engineering and Information Technology
EE: Eesti (Estonia)	*Informatsioonitehnika* It consists of the following curricula (specialities): • *Arvuti- ja süsteemitehnika* • *Elektroonika* • *Informaatika* • *Telekommunikatsioon*	Information technology It consists of the following curricula (specialities): • Computer and System Engineering • Electronics • Informatics • Telecommunication
	Infotehnoloogia Elektrotehnika	Information Technology and Electrical Engineering
ES: España (Spain)	*Ingeniería Eléctrica, Informática y de Telecomunicación*	Electrical Engineering, Informatics and Telecommunication Engineering
	TIC: Tecnologías de la Información y de las Comunicaciones	ICT : Information and Communication Technologies
FI: Suomi/ Finland	*Sähkö – ja Tietotekniikka*	Electrical and Information Engineering
FR: France	*Electronique, Electrotechnique et automatique*	Electronics, Electrotechnics and Control
	Informatique	Informatics, computers
	Nowadays, the French CNRS (National Centre for Scientific Research / *Centre National de la Recherche Scientifique*) uses the expression *STIC (Sciences et Technologies de l'Information et de la Communication* / Information and Communication Sciences and Technology).	
GR: Ελλάς (Greece)	Ηλευτροτεχϖολγφια Ηλευτροϖιριυ τυ βεπρνϖιριυ	Electrotechnic, Electronic, Control
	Ηλευτρολογοσ Ηνξολϖολογοσ	Electromechanical Engineering
	Ηλεκτρονική και Τεχνολογία Πληροφορικής	Electronics and Information Technology
	"*Electrologos Mechanikos ke Mechanikos Pliroforikis*" or "*Electrologos Mechanikos ke Mechanikos Ypologiston*"	Electrical and Computer Engineering
HU: Magyarország (Hungary)	*villamosmérnök*	electrical engineering
	műszaki informatika	information engineering
IE: Éire /Ireland	The title 'Electrical and Information Engineering' does not tend to be used in Ireland, though Electrical Engineering and Information Engineering or Information Systems Engineering are used separately. Electronic Engineering, Computer Engineering, Software Engineering and Telecommunications Engineering are also popular terms. The term ICT (Information and Communications Technologies) is now the most popular term used to describe the EIE disciplines.	

IT: Italia (Italy)	*Ingegneria Elettrica e dell'Informazione*	Electrical and Information Engineering
LT: Lietuva (Lithuania)	*Elektros ir elektronikos inzinerija*	Electrical and Electronics Engineering
	Informatikos inzinerija	Information Engineering
LV: Latvia	Major integral fields: • *Elektrozinātne* • *Datorzinātne un informāciju tehnoloģijas* Some specialisations: • *Datorvadība* • *Elektronika un telekomunikācijas*	Major integral fields: • Electroscience (Electrical Engineering) • Computer Science and Information Technologies Some specialisations: • Computer Control • Electronics and Telecommunications
NO: Norge (Norway)	*Informasjonsteknologi og elektroteknikk*	Information Technology and Electrical Engineering
PL: Polska (Poland)	*Electronika, Elektrotechnika, Informatyka*	Electrotechnics, Electronics, Informatics
PT: Portugal	*Engenharia Electrotecnica e Informatica*	Electrical and Information Engineering
RO: Rômania	*Electronica si Ingineria Informatiei*	Electrical and information engineering
SE: Sverige (Sweden)	*Elektroteknik* *Datorteknik* *Informationsteknolgi*	Electrical engineering Computer engineering Information engineering
SK: Slovensko (Slovak. Rep.)	*Elektrotechnické a informatické inžinierstvo*	Electrotechnical and Informatic Engineering
UA: Україна (Ukraine)	*ЭЛЕКТРОТЕХНИКА И ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ*	Electrical engineering & information technologies
UK: United Kingdom	The term ICT (Information and Communications Technologies) is now the most popular term used to describe the EIE disciplines.	

2.3. Conclusion

As we can see from this short study, the name of our set of academic fields in English speaking countries, can be different. EECS is commonly used in the U.S., ICT is common in the UK and Ireland and EIE is used in Australia and South Africa and was chosen by the EAEEIE (European Association for Education in Electrical and Information Engineering). It is important to keep these aspects in mind when searching information for on the internet, and also when we want to register websites on the internet.

In European countries generally, there are two main sub-fields of EIE, one related to electrical or electronic engineering and the other one related to information technology or computer science. The trend is now to have more and more interactions between these two fields, due to the evolution of these technologies and their applications.

3. Actual implementation of the Bologna-BMD scheme in Europe

(overview with the partners of THEIERE and EAEEIE)

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In order to have an idea of the present policy of implement of the BMD (Bachelor Master Doctorat) model proposed by the European Commission around Europe, a survey has been done with the partners of THEIERE and EAEEIE, in November 2001 and August 2002.

Fundamental objectives of Bologna process:

The Bologna Declaration has been signed in June 1999 by a group of European Education Ministers from 29 countries. The goal is mainly to obtain a convergence of their higher education systems to improve students and teacher mobility within Europe. The Deadline set for the implementation of the Bologna process is 2010. The figure 1 gives the timetable of the propose implementation. Two years after signing the Bologna Declaration, higher education Ministers of 32 European signatory countries met on 19 May 2001 in Prague to follow up the Bologna Process. All countries involved in the Bologna Process are asked to present their country reports for the next Meeting in Berlin in September 2003.

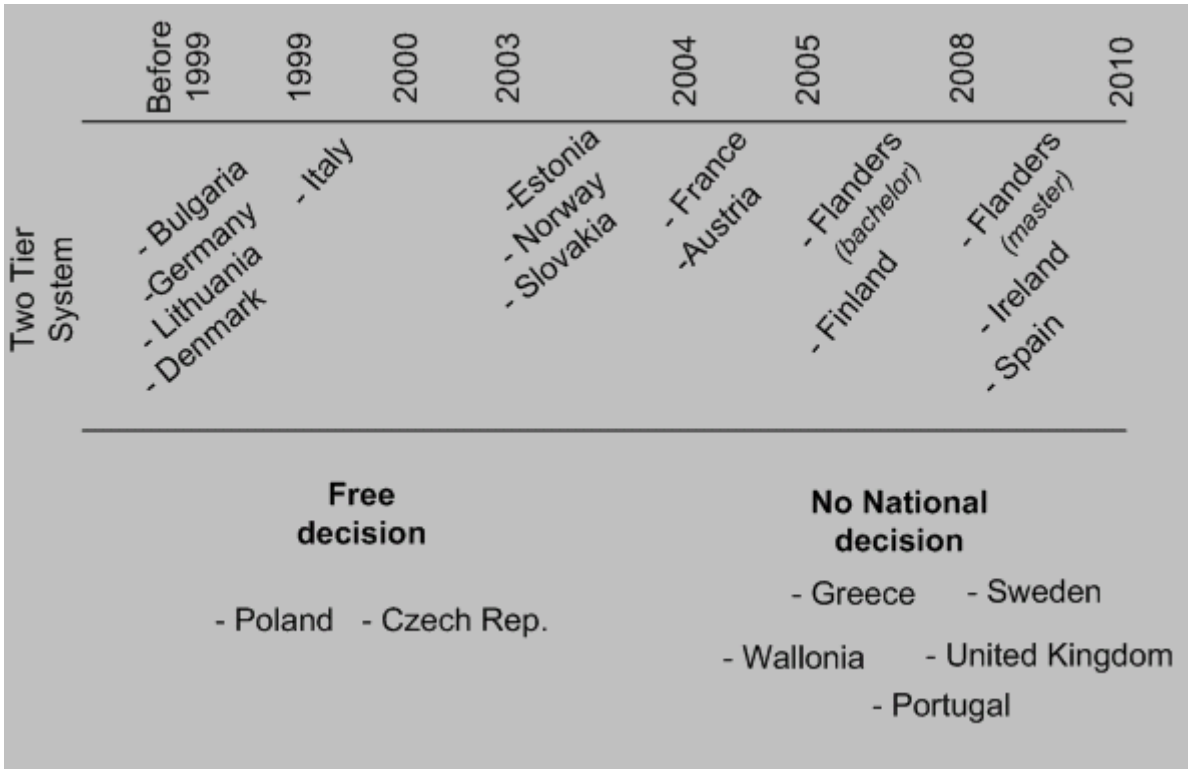

Figure 3.1: Timetable of the Bologna process

Questions :

In relation to the implementation of Bologna BMD scheme, Could you please let us know what is the present position in your respective country?

- Do you know if some universities have implemented this new scheme?
- Is it done at a national level in your country?
- What are your experiences and what are the difficulties?
- We know that in Italy this scheme has been implemented, do you have some experience?

Countries	General Information and Specific Answer
AT: Österreich (Austria)	General information [REF 1], [REF 2] ''In **Austria**, the possibility to offer Master programmes of 60–120 credits (and Bachelor programmes of 180–210 credits) at universities has been introduced in 1997. The new Austrian higher education law will also entitle Fachhochschulen to offer Bachelor and Master programmes. Some problems regarding the professional status of the new degrees, in particular the Bachelor, still have to be solved. After being discussed in the National Council (Nationalrat) and Federal Council (Bundesrat), a new university act became effective in Austria in October 2002. As part of a comprehensive university reform, the law should crucially strengthen the autonomy of universities. Thus far, the universities have been overseen by the Ministry of Science, but from now on they will be responsible for their own economic, personnel and strategic decisions. One condition for this is the legal autonomy and the change of the organisational structures. The 'University Act 2002' is integrating itself into the reform process of European universities, initiated in Bologna in 1999, and will be implemented at the beginning of the year 2004 when all new study programmes – with the exception of medicine, etc. – have to be organised in the Bachelor/Master structure.''
BE: België/ Belgique/ Belgien (Belgium): Vlaanderen (Flanders)	General information [REF 1], [REF 3] ''In **Flanders**, the first university degree (licentiaat/engineer) is awarded after 4 of 5 years, the intermediate degree (called kandidaat) after 2 years. After the Bologna process a new proposal was discussed. A new higher education law has now been proposed that will restructure university study programmes into a Bachelor programme of at least 180 ECTS credits and a Master programme of at least a further 60 ECTS credits. Both the universities and the hogescholen (higher school) will offer the new degrees. Only the hogescholen associated with a university will been allowed to offer Master programmes in order to ensure a quality control and the necessary link to research. The law foresees the introduction of the new Bachelor programmes by 2004/05 (The draft text of the Decree can be consulted on the Internet at: http://www.ond.vlaanderen.be/hoger_onderwijs/structuurdecreetstart.htm) and of the Master programmes by 2007/08 (in time for the first Bachelor graduates). From 2010/11, the two-tier system should have fully replaced the existing one. '' Specific view provided by Theiere partner *…The old situation in Belgium was, for the university engineering degrees:* *- 2 years: candidates degree* *- 2+3 years: engineering degree* *In the Dutch-speaking part of Belgium the minister of education of Flanders (responsible for educational matters in this part of Belgium) has published a new version of the law which converts the 'old' engineering degrees to Master degrees ; the bachelor degrees replaces the previous 'candidates' degrees. Thus 2+3 has been converted to 3+2.* *The situation for the non-university engineering degrees (the so-called 'industrial engineering') is not clear yet; the schools ask for a 5 year curriculum (now 4 years) while the minister does not seem willing to spend more money by prolonging the studies.* *The three universities which are allowed to offer engineering degrees (Gent, Leuven and Brussels) are working on the new curricula…*

	Other specific view provided by Theiere partner *…We have a 3 tier system.* *1. Universities now offer a 5 year programme (2+3) + Phd which will be transformed into academic bachelor (3) + master (2) + Phd (min. 2).* *2. The hogescholen now offer a 4 year programme (2+2) of academic eduction. This which will be transformed into bachelor (3) + master (1). Master degrees will only be accreditated if the hogeschool makes an association with a university.* *3. The hogescholen also offer a 3 year programme of Professional Education. This will automatically be transformed in a bachelor. This bachelor degree is different from the previous one. It is a professional or vocational bachelor, and minimum one bridge-year will be required for having access to master studies..*
BE: België/ Belgique/ Belgien (Belgium): Wallonie (Wallonia)	General information [REF 1] ''The programmes at universities and Hautes Écoles are formally divided into two cycles, the first one leading to the intermediate degree of a candidat after at least two years. The second leading, at least in the universities, to a degree at Master level after another two, three or even four years. The degree awarded after the second cycle is called licencié, maître, ingénieur for the university programmes and licencié, ingénieur commercial/industriel for the programmes at the Hautes Écoles. The Bologna Process has led to discussions on a possible adaptation of the programme structures at universities and Hautes Écoles to the pattern of the Bologna Declaration. During a joint meeting in March 2002, the Ministry of Higher Education and Research and the rectors came to an agreement for the introduction of Bachelor and Master degrees. No legal decision has been taken yet but the following structure is being considered: a two-tier structure with a first degree after three years/180 ECTS credits and a maîtrise degree after one to two further years (60–120 credits), depending on the discipline.''
BG: България (Bulgaria)	General information [REF 1], [REF 4] ''In **Bulgaria**, the two-tier system was introduced in 1995 with the new Higher Education Act. Only the universities and specialised higher education schools at university level offer a Master degree of 1 year, building on a Bachelor of 4 years. Actually, the ECTS system has been implemented in several higher education institutions. The 2003 draft of the Higher Education Act foresees adoption of the ECTS system by all higher education institutions.'' Specific view provided by Theiere partner *…Currently Bulgaria implements a 4-5-8 scheme for engineering education.* *There are not any discussions about implementation of new 3-5-8 scheme …*
CZ: Česká republika (Czech Republic)	General information [REF 1] ''In the **Czech Republic**, the two-tier curricula are more and more replacing the one-tier programmes. Non-university higher education institutions have traditionally been concentrating on Bachelor programmes and only very few among them also offer some Master programmes. The new Master degrees can require 60 to 180 ECTS credits, most of them being of the 120 credits type. They are offered in engineering.'' Specific view provided by Theiere partner *…Since this year is in the Czech republic valid the new Higher Education Act where there is defined the three stage system where the standard length of the bachelor stage is between 3 and 4 years, the standard length of the master stage is between 1 and 3 years and the length of PhD stage is 3 years. If the character of field of study needs the long master study period without the previous bachelor stage it may be permitted this master study with the standard length between 4 and 6 years (it is supposed this exception will be used for medicine, jurists etc. but there are universities trying to use this exception for all study areas).* *Specially in electrical engineering the main Czech universities are preparing the system 3+2+3 and it is supposed to start this new approach after accreditation in the year 2003…*

	Other specific view provided by Theiere partner *… Recently (just few weeks ago) we have finished new curricula as part of a long list of documents required by the Czech Ministry of Education for accreditation process. We applied the same scheme, namely 3-5-8. Or in other words: 3 years for bachelor, 2 years more for master, and 3 years more for PhD…*
DE: Deutschland (Germany)	General information [REF 1], [REF 5], [REF 6] ''In **Germany**, the two-tier structure has been introduced in 1998 on an experimental way: But the one-tier programmes still exist. Universities and Fachhochschulen (universities of applied sciences) were allowed to introduce Bachelor and Master programmes, applying either a 3+2 or a 4+1 model. In January 2000, the Science Council, issued a recommendation concerning the introduction of a new study and degree structure (Bachelor/Master) in Germany. The new degrees are given much attention in the recent recommendations of the Science Council concerning the development of universities of applied sciences (Fachhochschulen) of 18 January 2002. The Science Council recommends that the new graduation system should be introduced at Fachhochschulen. In the 2002 summer semester, 544 Bachelor courses and 367 Master courses will be offered by higher education institutions in Germany.'' Specific view provided by Theiere partner *…In Germany there is also a strong political push towards the 3-5-8 system, however so far there is no requirement to convert existing courses. In fact, our school just simultaneously received permission for a new "conventional" Diplom-Ingenieur (4,5 years) degree and a Bachelor/Master degree suite, from the same ministry. Hence, the B.Sc./M.Sc. programs are more seen as an additional means of diversification. In Germany, though, this strongly depends on the "Land" you are in - I can speak for Baden-Württemberg only. The major problem is the unknown acceptance of Bachelor degrees in industry. Just recently, it was decided to convene a survey commission at the state level for that purpose. Some considerations at the federal level: The federal government sets the legislative framework through the "Hochschul-Rahmengesetz", which, since late 1998, also contains Bachelor and Master as possible degrees. Conceivable, the could force an immediate conversion to the 3-5-8 system by modifying that law (i.e. eliminating the 5-year degrees and mandating a maximum 3-year doctoral period), but that would probably not pass the second chamber of the German parliament, the "Bundesrat", which represents the Länder (a bit like the US senate). Also, there is no talk about such a law right now.It seems there are no plans to force the Bachelor/Master system. In other "Länder", it might be different. I know that in Northrhine-Westfalia, the pressure has been much higher to convert to a Bachelor/Master system, but even there universities are not legally forced to abandon the monolithic 5-year programs.*

	Other specific view provided by Theiere partner *In 1997 we got a new law from the Federal Government which offered the possibility to create new courses under the 3-5-8-scheme. In Germany we have 16 Länder and they are responsible for the Research, Education and Science. All Länder renewed their laws and they forced the universities and the Fachhochschulen (now Universities of Applied Sciences) to start with new curricula, offering Bachelor and Master degrees. At the moment we can do it in parallel to the Diploma but probably in some years, having some experience with the new curricula, we will have to make a decision which line we will follow in the future. The politician, of course, expect, that we will follow the 3-5-8 scheme.* *What is the situation in electrical engineering and information technology in 2001?* *We have 32 faculties in Electrical Engineering and Information Technology (ETIT) at the University level (not Fachhochschule). Some of these faculties offer Bachelor and Master courses, but they did not cancel the Diploma courses. In some cases they offer Bachelor/Master Courses in special fields with very attractive names. (As you know we had a sharp decrease in applications for ETIT; so many faculties feel a possibility to "catch" students.) Some other faculties offer only special Master courses (in English) to attract student from abroad. The success varies from University to University.* *For PhD we do not have special programs in Germany. There is only the tendency to shorten the time for getting the Doktor degree.*
DK: Danmark **(**Denmark)	General information [REF 1], [REF 5] , [REF7] ‘’In **Denmark** The degree structure follows a primarily Anglo Saxon model with 3–3 1/2 year study programmes for a bachelor’s degree, a further 2 years’ study for a master’s degree (called Candidatus degree) and another 3 years for a PhD degree. All programmes include the preparation of either a major project report, a thesis, or a dissertation, depending on the degree. At the end of the 1980s, Denmark started to offer Bachelor programmes of 3 to 3,5 years and Master programmes of another 2 years. Under the impulsion of the Bologna discussions, the conversion process has now gained speed and the introduction of a two-tier structure in all disciplines has been decided and is almost completed. Master degrees are only offered at the universities. The Diploma Supplement is to be implemented by law from September 2002. All higher education institutions are obliged to issue a Diploma Supplement in English to all students granted after this date.’’
EE: Eesti (Estonia)	General information [REF 1], [REF 8] ‘’In order to render the Estonian higher education system comparable to the systems of other countries in this region and open up better opportunities for higher education graduates to be competitive on the European labour market, Estonia is gradually implementing the reform plan *“Higher Education Reform, 2001–2002”* approved by the Government on June 12, 2001. In the framework of the reform, the objectives of the Bologna process are being followed. Legislative changes (amendments to the *University Act* and related legislation) for implementing the two-tier BA-MA system have been debated in the Parliament in the first half of 2002 and were adopted in June. Most of the universities transferred to the new degree structure as of the 2002/03 academic year. In **Estonia** now the majority of programmes today is structured in two tiers. Since the Academic Year 2002/03, the Master degree (Magistrikraad) requires 60 ECTS credits if it follows a Bachelor of 240 credits and 120 credits after a Bachelor of 180: the total number of credits for a Master degree has to be 300. The 3+2 model is more common than the 4+1 model.’’ Specific view provided by Theiere partner *… In the moment we have the system: 4+2+4.. Starting from 2002 we will move to 3+2+4….*
ES: España (Spain)	General information [REF 9], ‘’In **Spain**, The Ministry of Education submitted to the University Council a framework document outlining the main features of the reform of higher education system in accordance with the Bologna process. The document proposes the replacement of the

	Spanish credit accumulation system, based on the number of class hours, with the one based on the total duration of studies, the implementation of 3+2 Bologna degree structure, the introduction of diploma supplement, and measures to strengthen quality assurance mechanisms. The report recommends gradual adoption of the new system form 2004/2005 onwards and its full implementation in all higher education institutions by 2010. (ACA-Newsletter, No. 27) *22.07.2003"* Specific view provided by Theiere partner *…As far as I know about the educational system in Spain, we have not a unique system, but depends on degrees and /or Universities.* *After the Bologna declaration our Rectors (I mean of Engineering Schools) are discussing about the adoption of a 3-2 scheme or a 4-1.5 one. In fact, the University legislation is currently been changed, without including these aspects…* Other specific view provided by Theiere partner *…In Spain we have a system:* *3 years for Diplomate Studies.* *5 years for Licenciate Studies or Engineering Studies* *then* *6 years if the student follow Master (not recognised officially)* *7 years if the student does the Doctorate courses…*
FI: Suomi/ Finland	General information [REF 1], [REF 5], [REF 10], [REF 11] ''In **Finland** The system of higher education degrees will be developed to correspond to the needs of working life and also in view of the international development of degree structures. Finland is currently introducing the new type of Master programmes. The Ministry of Education is promoting the development of the two-tier system, as the Bachelor programmes that were introduced in the 1990's did not lead to independent degrees but were part of the Master programmes of 5 years. With the new structure, Finland wants to increase the international comparability of its degree structure and national and international mobility as well as cater to the needs of working life. The Finnish Higher Education Evaluation Council (FINHEEC) published an evaluation report on the existing Master programmes in February 2002. A working group of the Ministry of Education has given its report on the proposals for action on the national level at 31.10.2002. The following goal will be implemented in a new legislation in the university sector in 2005: Degree system (Two-tier degree system for all areas of High Education in universities, bachelor's degree 180 credits and 3 years and master's degree 120 credits and 2 years), Mobility and flexibility, Adaptation of ECTS-based credit system and Evaluation of new degrees. The new Master programmes take normally 2 years to complete and are offered only at universities. Finnish universities and polytechnic legislation obliges Higher Education Institutions to provide their students, on request, with an annex to their diploma for international use issued in English. The Finnish Ministry of education has recommended that all institutions follow the Diploma Supplement developed by European Commission/Council of Europe and UNESCO.'' Specific view provided by Theiere partner *…There have been discussions in Finland about the topic. I think that the Finnish industries are happy about the present structure. Finnish system does not conform with the planned 3-5-8 system but is not far from that…*
FR: France	General information [REF 1], [REF 12] ''**France** has taken an important reform decision. A first outcome was the decision in 1999 to make the licence a genuine terminal degree relevant to the labour market, and to launch the "licence professionelle". In April 2002 the government signed several legal texts, pertaining amongst other matters to the introduction of a 3+2 structure in the universities, with a licence and a Master, starting with the Academic Year 2002/03. There will be two different profiles of Masters – research Masters and professional Masters (*diplôme national de "Master", à finalité "recherche"* or *finalité "professionnelle"*, the latter possibly requiring an internship).. Also the *Grandes Écoles*

	will begin to introduce the new Master degree. Linked to the different « waves » of contractualization already defined in France according to geographical areas, the reform should be made real everywhere round the country by the academic year of 2003/2004.'' Specific view provided by Theiere partner *…At the present time, some discussions are made, within the frame of the 4-year conventions between the French minister of education and the universities.* *The French Club EEA (http://www.clubeea.org) runs as a forum in order that there are concertations between French universities at the moment to implement the scheme, at least in our field…*
GR: Ελλάς (Greece)	General information [REF 1] [REF 13] ''In **Greece**, there is a strong scepticism concerning the establishment of the bachelor degree after at least three years of studies. The first higher education degree in Greece is the Ptychio or Diplom, awarded after 4–5 years. The universities offer one type of Master degree of 1–2 years, called "postgraduate diploma of specialisation". Although the Greek system consists formally of two tiers, the large majority (around 75 per cent) of the students leave the system with the Ptychio and do not continue their studies towards a Master or a Ph.D. Master degree are and will be offered exclusively by universities. However, a recent change of law upgraded the Technological Educational Institutions (TEI), making them part of the Greek higher education system. This means that TEI, after successfully passing a quality assessment procedure, may now cooperate with universities in Master programmes, contributing their staff, facilities or equipment. The Master degree will, however, in all cases, be awarded by the university.'' Specific view provided by Theiere partner *…According to this matter, the educational system is far too complicated. For example the studies in all Universities last 4 years, the Politechnical Schools last 5 years including Master, the Medicine Schools last 6 years, the Technological Educational Institutes last 3,5 - 4 years etc. There are also many arguments related to this subject and the change of the current model. As you see the 3-5-8 scheme can not be yet implemented. Despite this the government have the intention to apply it but it will be very difficult…*
IE: Éire /Ireland	General information [REF 1] [REF 14] ''The Irish system is traditionally based on two cycles: undergraduate and postgraduate. In **Ireland**, a Master degree, following a Bachelor of 3–4, requires 1–3 years of study. All types of higher education institutions are entitled to offer Master programmes. There are no long integrated Master programmes in Ireland.'' Specific view provided by Theiere partner *…In Ireland the Primary or Bachelor's Degree is usually of four years duration, the Masters Degree takes a further one or two years and the final qualification, the Doctorate takes three years. Therefore in effect Ireland has a 4-5-8 system. The situation in Ireland is further complicated by the funding arrangements that are currently in place. The Government pays the students' fees for the Bachelors Degree, but the students pay fees (subsidised by the state) for the Masters and Doctorate degrees. Thus at present the majority of students finish after four years and go to work in industry, commerce, etc., with only a small percentage going on to do a higher degree. Thus the Bologna Declaration of 3-5-8 presents a dilemma for the Universities in Ireland - should we reduce the initial qualification to 3 years and produce less qualified graduates or should we lengthen our programmes to 5 years and make the Masters Degree the main qualification, which would require significant extra funding from the state? Therefore the Bologna Declaration is the topic of ongoing discussions in Ireland and particularly so for engineering education, where there is a professional body that has reciprocal accreditation arrangements with other professional bodies in Europe and worldwide. However, to date no programmes in any University in Ireland have yet been changed as a result of the Bologna Declaration…*
IS: Island	General information [REF 15] ''The Ministry of Education, Science and Culture has decided to formalize and

(Iceland)	strengthen the implementation process. A special coordination and advisory committee has been established consisting of representatives from all higher educational institutions in **Iceland** and from the Ministry. The committee will monitor the progress of the Bologna process in Iceland and give input and make suggestion as to changes in laws and regulations that might be necessary to secure successful implementation. In Icelandic universities is still two system. In the first one there is the dominating bachelors/masters degree system. The bachelors' degree is obtained after 3-4 years and the masters' degree after two additional years. In some disciplines it is also possible to study 3-4 years for the doctors degree. The two cycle system (3+2) was established in the humanities already in 1942 by a university regulation, introducing the bachelors degree after 3 years of study. The same system is now also used in the natural sciences, engineering and economics. In the second one there is the older and gradually disappearing candidates degree system, the degree is obtained after 4-6 years of study; mainly in the traditional professional/academic disciplines. Since 1942 the traditional candidates system has in some disciplines been changed into the bachelors/masters/doctors system, i.e. the 3+2+3 system (or 4+1+3), or there is a mixture of both systems. Thus: There is in place a system that is generally based on two main cycles, undergraduate and graduate. Access to the second cycle requires successful completion of first cycle, lasting a minimum of three years. The degree awarded after the first cycle is in general terms also relevant to the European labor market as an appropriate level of qualification. The second cycle leads to the masters degree as in many other European countries.''
IT: Italia (Italy)	General information [REF 1] ''In **Italy** A Ministerial Decree of 1999 re-defined the structure of Italian higher education degrees. At the undergraduate level, the *laurea* is now being awarded, normally after 3 years or 180 ECTS credits. At the graduate level, two degrees are awarded. The most important one is the *laurea specialistica* which is awarded at a level of 300 credits and therefore requires normally 2 years or 120 credits of study. There is also a postgraduate specialisation degree, the *Master universitario di primo livello* (1 year or 60 credits), but it is not part of the consecutive two-tier system. The new law mentions three more degrees: a research doctorate, a *diploma di specializzazione* (1–5 years/60–300 credits, providing skills for particular professional activities) and a *Master universitario di secondo livello*, of 1 year/60. The new *laurea specialistica* is offered at universities and other academic institutions. '' Specific view provided by Theiere partner *…For your information in ITALY all the university starting from this year have implemented the scheme 3+2+3 . The first degree of three year is the Laurea The second degree after 5 years the Laurea specialistica and the last after 8 years the dottorato di ricerca. However are possible Master degree of 1 year both after the Laurea (3 years) and after the Laurea Specialistica (5 years)…*
	Other specific view provided by Theiere partner *…in Italy the 3-5-8 scheme (i.e. 3 plus 2 plus 3 for PHD) has been recently introduced and is now working in practically all our Faculties of Engineering. The first three years give a basic degree in Engineering; the following two years give the so-called specialistic degree, while three more years are needed to get a PHD in Engineering in our University. It would be nice for us to see that this type of scheme is going to be wide-spread among European Universities. At present I dare say that dealing with this scheme is not an easy job for us, since it made a great change with respect to the old system.The basic problem is giving a valid preparation in applied engineering subjects without having a strong background in mathematics and physics as in the traditional scheme…*

	Other specific view provided by Theiere partner *…I've heard that in Italy this scheme has been implemented, do you know?* *it's true. we started to implement a 3-5-8 scheme two years ago (1st and 2nd year in parallel, so that we graduated first students July 2001).* *3 years for bachelor (laurea)* *2 more years for master (laurea specialistica)* *3 more years for PhD (dottorato di ricerca)* *main problems at present lie in the fact that we have to manage both the old structure (old laurea, 5 years) and the new one, without new resources (teachers), no rooms to differentiate classes. So at present the feeling is not so nice. but we should fix these problems in a couple of years (it means that a.y. 2003-2004 will not have any overlaps, as the old laurea courses will be extinguished on 2002-2003)…*
	Other specific view provided by Theiere partner …in Italy this new format (that we call 3+2) is mandatory at national level, from the current *academic year 2001-2002 and it is implemented by almost all universities and faculties (as far as I know, in the engineering field it is not followed by Civil (Construction) Engineering) and also, I believe, Medicine). There have been obvious difficulties in implementing the scheme because it is quite difficult to have a three year course that is allowing the entrance into the engineering profession and, at the same time, preparing for a further study. The approach followed has been to reduce all the basic contents of the former five year curricula to the essentials, and to squeeze them into the three years.* *After the three years the students will get a title with the same name as before (Laurea), while, after the five year, a new title called "Laurea Specialistica". I have no idea on how the industry will receive the new graduates.* *I believe industry has played a very marginal role in the decision process regarding the implementation of the new scheme, as well as university itself, because the reform has been, basically, dictated by the ministry without a decent consultation and discussion with the interested parts…*
	Other specific view provided by Theiere partner *…Our Faculty has just started with the 3+2 program. Actually, we started with the first two years and every academic year the program is extended to the following year. Therefore, the first graduates are expected within about two years.* *Other universities in Italy (e.g. the two main universities in Rome), have activated the 3+2 over the five years.* *We do not have yet feedback over the complete cycle of studies.* *The industry should be somehow interested in recruiting younger graduates, so that achieving a degree after 3 years should be OK for a number of positions, where the job is more routine than innovation. The further two years should be devoted to obtain a specialist degree in a discipline. The process can be completed by a Ph.D. program.* *There is the possibility for a Faculty to promote one-year Master programs on specific topics, both after the first three years (3+1) and after the five years (3+2+1). Some universities have started with Master programs this year, we are thinking about starting with the next academic year. There should not be a program at a national level outside the 3+2+3, unless the newly arrived Ministry decides to introduce modifications.* *As I said before, we should wait for significant feedbacks before evaluating the new program. My personal opinion is that three years is a too short time to provide a solid background in physics and mathematics and at the same time provide professional skills. I would have preferred a 4+2+2 (or 4+3), at least in Engineering, as I could find in most programs of North-American universities.* *Just to conclude, I do not really know what kind of advise can be provided. In our case the 3+2+3 is a constraint at a national level, so that any effort is being spent to let the new programs can work at their best…*

	Other specific view provided by Theiere partner *…Unfortunately in Italy we are experimenting the scheme 358. We are now at the 2nd of the first three years. I personally believe that this new organisation of the studies represent the dead of our traditional culture and I am no yet sure that it will be capable to prepare people which will be successfully employed in the working world.* *At the beginning we had some difficulties in reducing the contents of ground lectures. According the actual experience it is not yet definitively clear the differences between technicians, formed at high school and people coming from the University…*
	Other specific view provided by Theiere partner *…These are the summary information I can provide for Italy:* *We have started to move to the 3-5-8 scheme (previously it was 3 OR 5-8, the student had to choose at the very beginning between 3 and 5).* *The technical university are well on in the move (some have already the full 3Y curricula in operation, other - like here - are now at the II Y of the new scheme).* *Many non-tech universities (medicine, economy, ...) resisted, and now it is not clear what the (new) government plans to do: maybe these universities will be allowed to keep the old scheme…*
LT: Lietuva (Lithuania)	General information [REF 1], [REF 16] ''In **Lithuania**, there are Three-stage structure of study programmes: 1] Undergraduate (bachelor degree, professional diploma), duration at least 3 years (120 credits) (for colleges) or at least 3,5 years (140 credits) for Bachelor degree or (and) professional qualification. 2] Graduate (master degree, professional diploma) (at least 1,5 year, 60 credits). Some undergraduate and graduate programmes might be combined (total duration at least 5 years or 200 credits). 3] Doctoral studies (3-4 years) or aspirancy for arts (2 years). Doctoral degree might be awarded only after defending of thesis. Only the universities offer 90–120 ECTS Masters. The cycle duration of study for a master is up to 5 years or 300 credits.'' Specific view provided by Theiere partner *…In Lithuania we have a system of 4-6-9 years…*
LV: Latvia	General information [REF 1], [REF 17] ''In **Latvia**, Bologna process did not initiate reforms in higher education but rather shaped and directed them into the direction of higher education reforms in Europe on the way towards European Higher Education Area graduate Master degrees (of 60 to 120 credits) were made as a purely academic degree. The amendments to the Latvian Higher Education Law of 2000 introduce professional Master degrees. Both universities and academies on the one hand, and professional higher education institutions on the other may offer Master degrees. The law foresees that, programmes leading to a bachelor or master degree are, where possible, at the same time oriented towards a profession and meet its standard. Where it is not possible, programmes should ensure a sufficient level of transferable pedagogical modules so that even at bachelor level holders can successfully find their needs for professional orientation. The total duration of studies should not be less than 5 years (300 ECTS or 200 Latvian credits). '' Specific view provided by Theiere partner *…In the Riga Technical University, largest HE institution providing engineering education in Latvia, 3 year (180 ECTS) Bachelor studies were introduced in the early 90s. It was treated as an intermediate qualification before choosing between professional programmes (1-2 years, 60-120 ECTS) and Master studies (3 years, 180 ECTS). This was a 3-6-9 system. There were also introduced 4 year study programmes leading to Engineer qualifications (without a Bachelor degree), but not allowing continuation in Master studies as a Bachelor is required.* *In December 2000 the Law on Higher educational establishments was amended in the spirit of the Bologna declaration. According to these amendments the Law provides for the award of a professional bachelor degree (if the total duration of the programme is no less than 4 years, 160 Latvian credits, 240 ECTS) and a professional master degree (if the total duration of the programme is no less than 5 years (= 200 Latvian credit points or 300 ECTS credits). Thus, in the long run the reforms will lead to a*

	symmetric degree and qualification system shown in the Diagram of Latvia Higher Education System (see second part of the monograph, the part dedicated to Latvia). *From September 1, 2002 Master degree programmes could not be longer than 2 years; it means mainly 3-5-8, but allowing other schemas too, as 4-6-9, 4-5-8…*
NL: Nederland (Netherlands)	General information [REF 18] ''In september 2002 a bachelor-master's structure was introduced in higher education in the **Netherlands**. The universities have converted most of their traditional "one-cycle" programmes to bachelor and master programmes. For the time being, "one-cycle" programmes may continue. Bachelor degrees require 180 ("ects"-)credits in academic education and 240 credits in higher professional education. The primary aim of the professional bachelor is to move on to the labour market. The academic bachelor's primary aim is to follow a master programme. However, an academic bachelor can also opt for entering the labour market. Master's degrees in academic education require 120 credits in engineering. Master's degrees in higher professional education require a minimum of 60 credits.''
NO: Norge/ Noreg (Norway)	General information [REF 1], [REF 5], [REF 19] ''In **Norway**, many university professors argued strongly against the change from a four-year degree to a three-year bachelor-degree. The parliament adopted a new degree system in June 2001 which will be introduced between autumn 2002 and the end of 2003. The new system follows the 3+2+3 pattern. In addition to the 120 ECTS Master, there is an international Master (60–90 credits) and an experience-based Master (60–90 credits). All public higher education institutions – universities and state colleges – will offer the new degrees. Bachelor and Master's degrees will be introduced, not by law, but by Government decision. The revised law gives universities full freedom to start any course at any level; state colleges will have such rights for lower level degrees. The Law on Private Higher Education has also been changed and a new Law on Higher Education (state and private) is envisaged as the next step in the process of giving the institution greater autonomy, but at the same time also greater responsibility. The reform also includes implementation of the Diploma Supplement. They will be issued automatically.'' Specific view provided by Theiere partner *…Many universities and colleges in Norway are also in the process of adapting the bachelors, masters and PhD model. There are already in some universities masters degrees. The trend is to implement this 3-5-8 model as a parallel alternative to the existing model. In due course, they might switch over to the 3-5-8 model. This might take a long time*…

PL: Polska (Poland)	General information [REF 1], [REF 20] ‘’**Poland** had since a long time a one-tier system. These take 5–5.5 years and lead to a degree at Master level called Magister (Jednolite studia magisterskie). In addition, there are professional programmes of 3–3.5 years, finishing with a licencjat degree (in arts, science and related areas) or programmes of 3.5–4 years, finishing with an inzynier degree (in engineering, agriculture, management and related areas). There has been the possibility for holders of a licencjat or inzynier degree to do a Master degree (usually 2 years). Since Bologna process, many higher education institutions have abandoned the traditional model of 5-year integrated Master programmes and moved to two-tier programmes in which the first degree (licencjat or inzynier) corresponds to a Bachelor degree, to be followed by a Master degree (Uzupelniajace studia magisterskie) of 1.5 to 2 years. working out the principles of issuing Diploma Supplement. All the new curricula will take the following Bologna directives : - working out and applying the credit system. Polish credit transfer system is being designed on the basis of ECTS commonly applied in Europe. - improving the education quality. Since 1st of January 2002 there have been activities going on to create a unified national system for accrediting higher education institutions. - further developing of two-stage study system, very popular in the EU member states; they are vocational studies ending in vocational Bachelor’s degree and additional Master’s studies which follow the first stage.’’ Specific view provided by Theiere partner *…This scheme has not been implemented at the national level in Poland. As far as I know no activity was undertaken in this matter yet…* Other specific view provided by Theiere partner *… In Poland at technical faculties 4-5-9 or 5-9 is mostly implemented. Few universities have 3,5-5-9 scheme. The scheme to be implemented is decided first by the faculty board, then voted by the university board ("Senat")…*
PT: Portugal	General information [REF 1] ‘’Also **Portugal** is still in the discussion process, although there is agreement among the principal actors on the objectives of the Bologna Process. The problem is how to adjust the existing four academic degrees Bachelor/bacharel, licenciado, mestrado and doctor to the Bologna principles. The Portuguese Rectors’ Conference (CRUP) adopted a statement in April 2002, proposing pragmatic solutions for the present situation and calling on the government to provide concrete definitions of the different cycles for the future, the specific distribution of tasks in the binary higher education system, requirements for accreditation and provisions for lifelong learning. For the time being, the transparency of Portuguese degrees should be increased by applying the following principles: the first level of graduation should be the licentiatura after 4 years, to be followed by a postgraduate formation of 1 year which corresponds to a professional Master degree (M.Sc.). The licentiatura can also serve as a starting point for an academic Master programme of two years or give access to a doctoral project. The discussion on whether to introduce a Bachelor-type degree after 3 or 4 years and the different implications that will have for the structure of the degree at Master level are still going on.’’ Specific view provided by Theiere partner *…For the moment, convergence is done by little steps.* *At my faculty the first year of Mater has been integrated in the 5 years graduation (new name - "Licenciatura com mestrado integrado") and it is possible to reduce the 5 years graduation for a 4 years graduation, making a year 0, replacing the secondary school final year…* Other specific view provided by Theiere partner *…In Portugal we have two different curriculum schemes at the Higher Education in EIE. The one gave by Universities is based in a first graduation level of 5 years (“Licenciado em Engenharia”). The other, usually given by “Politecnico”, has already a two-tiers structure: “Bacharel em Engenharia” (3 years) and “Licenciado em*

	Engenharia" (more 2 years). The title of Engineer is awarded by the Engineers professional body ("Ordem dos Engenheiros") for graduates holding a recognised course with a total of 5 years in Higher Education. By law and at the moment, only Universities are allowed to give pos-graduations titles like "Mestrado em Engenharia" and "Doutor em Engenharia". Foreseen evolution goes to a first level graduation during 3 / 4 years, a second level (with a total of 5 years of High Education) giving access to the professional title of Engineer, and a Doctoral program of 3 years. Only accredited high-education institutions will be allowed to propose pos-graduations courses giving access to the Master and Doctor degree…
RO: Romania	General information [REF 1] ''In **Romania** there are Master programmes of 1, sometimes 2 years duration in all disciplines. They are offered only at universities and build on undergraduate programmes of normally 4, in some disciplines 5 or 6 years. While the system consists formally of two tiers, the relatively long undergraduate degrees make the majority of graduates leave after the first degree. The situation therefore resembles that of Slovenia.''
SE: Sverige (Sweden)	General information [REFA 1], [REF 5], [REF 21] "At the moment the Ministry of Education carries out regional information campaigns about Bologna process and the Rectors´ Conference, the Swedish Government has set up an intra-ministerial working group to examine the present degree system from a Bologna perspective. In **Sweden**, there are both long integrated Master degrees, and degrees following a two-tier model. Bachelor of at least 180 ECTS credits or integrated Master degrees of at least 240 ECTS credits, without and intermediate Bachelor, are being offered in all disciplines. Master degrees of at least 60 ECTS credits, following a Bachelor of 180 ECTS credits, are also common. A new type of professional Master degree has been introduced only recently, called "Magisterexamen med ämnesbredd". This new professional Master degree is designed as an important element of lifelong learning, aiming at candidates who are already in employment. In engineering the Master degrees, "*Civilingenjör*", requires at least 270 ECTS credits and so far the study programs are integrated. This degree aims at work on advanced development of new technology built on scientific knowledge. The Bachelor degrees, "Högskoleingenjör", of at least 180 ECTS credits, generally follows a different curriculum from start and aims at work in industrial production. The fact that Swedish Masters can be awarded after only 240 credits might create difficulties when transferable accreditation is introduced in Europe. The Swedish higher education system consists of two main cycles, undergraduate (BSc/MSc) and graduate (PhD). According to the Swedish Ministry of Education the Bologna Declaration does not at present motivate any changes in the Swedish Degree structure but the Diploma Supplement was implemented in law 2002 and will be issued automatically together with the degree from 1 January 2003.'' Specific view provided by Theiere partner *… At Uppsala University a two-tier curriculum in Electrical Engineering is in use from the academic year 2003/04. A Bachelor degree will be awarded after completing 180 ECTS credits and a Master degree after additional 120 ECTS credits.…*
SI: Slovenija (Slovenia)	General information [REF 1] [REF 22] ''In **Slovenia** postgraduate degrees of 2 years/120 ECTS credits at Master level have been introduced by law (Higher Education Act of 1993, amended in 1999) and are offered in all disciplines by universities and other higher education institutions with faculty status. The Master programmes build on undergraduate degrees that require normally 4, but in some disciplines also 5 or 6 years of study. Since the study structure foresees one additional year for the preparation of a thesis, the overall duration of study for a Master degree goes well beyond the 5 years/300 ECTS credits that emerge as a standard in the Bologna Process. From 2001 to 2003, the Higher Education Council of the Republic of Slovenia assessed numerous new study programmes (21 postgraduate and 13 undergraduate), as well as revised programmes (25 in total).''
SK: Slovensko	General information [REF 1] **''Slovakia** is in the process of re-orienting its higher education system along

(Slovaquia)	"Bologna" lines. Thus, the new Slovakian Higher Education Law of 1 April 2002 distinguishes between study programmes of the first level (Bachelor), second level (Master) and third level (Ph.D.). Master programmes may last between one and three years. Three types of degrees at Master level exist: *Magister* (Mgr.), *Magister umenia* (Mgr.art) and *Inzinier* (Ing.). All study programmes are offered in the two-tier mode with the exception of medicine and veterinary medicine, which are explicitly excluded by law. Only in exceptional cases and after authorisation by the Ministry may universities combine programmes of the first and the second levels into one long programme. The traditional long programmes (4–6 years) still exist but will from now on be offered only in special areas and cases. They lead to the same degrees as the new, short Master programmes, namely: *Magister, Magister umenia, Inzinier*. '' Specific view provided by Theiere partner *…According to the valid HE law in Slovakia the HE institutions can run two cycle system, that is undergraduate cycle (Bachelor level with the nominal duration not less than three years) and graduate cycle (Master level with the nominal duration not more than two years).* *There is also a third cycle - or PhD. study with the nominal duration of 3 years in daily study or 5 years in part time form.* *The situation is in strong development. Not all HE institutions in our country are prepared to implement quickly the new system. In the past we had a rigid, one-cycle system with the duration of 5 years. There are many discussions concerning the duration of bachelor and master cycle, some people prefer scheme 3-2 and some 4-1,5. For the illustration at our faculty we run 4 year bachelor study and 1.5 master study. The reason for the 4 years bachelor cycle is quality, but opposition argues that it is too expensive and 3 years are sufficient for the industry requirements, and so on.* *It seems that under the strong influence of the development in EU countries outlined in Sorbona and Bologna declarations (1998,1999) the development in our country will follow the Bologna declaration features…*
TR: Turkije (Turkey)	General information [REF 23] ''The structure of **Turkish** higher education degrees is a two-tier system: undergraduate and graduate level of study. At undergraduate level, two year Associate's and four year Bachelor's degrees are awarded. Graduate level programmes consist of Master's (Yuksek Lisans Diplomasi) and Doctorate (Ph.D's) degrees. There are two types of Master's programmes: those requiring a thesis, and those not requiring a thesis.''
UA: Ukraine/ Україна And Others countries	General information [REF 24] ''Information on applications to join the Bologna Process: **Andorra**, **Bosnia and Herzegovina**, the former Yugoslav Republic of **Macedonia** as well as **Montenegro and Serbia** have already filed a formal application. **Albania**, the **Holy See**, **Russia** and the **Ukraine** have expressed their interest only informally so far. *11.02.2003"* Specific view provided by Ukrainian Theiere partner *…In all ukrainian universities the scheme 4(bachelor) - 5(two directions - Engineer (Dipl.-Ing) and Magister (Dipl.-Magister)) - 8(Ph.D.) is now implemented…*

UK: United Kingdom	*General information [REF 1], [REF 25]* ''In the United Kingdom, individual institutions have the possibility to award their own degrees. Universities are independent, self-governing bodies which have the power to award their own degrees. Colleges of higher education do not normally have degree awarding powers. A university will approve the colleges' courses. There are exceptions and a number of colleges of higher education have awarding powers. In England and Wales undergraduate degrees normally take three or four years of full-time study. In Scotland undergraduate degrees take four years of full-time study. Undergraduate degree courses in the UK are called Bachelor Degrees. When you have completed your degree, you will be awarded a class of degree depending on your academic performance, first-class honours (1st), upper second-class honours (2:1), lower second-class honours (2:2), third-class honours (3rd) Postgraduate studies : Diplomas and certificates are almost always taught course qualifications lasting 9-12 months full-time and two years part-time. The entry requirement is usually a good quality Bachelor degree (or first or undergraduate degree, as they are also called) or equivalent. Certificate courses are often shorter and at a lower level than diploma courses. Diploma and certificate courses may consist of the taught elements of a final-year Bachelor degree with Honours undergraduate course and/or a Masters course without the thesis. Some courses offer the option to transfer from a Diploma course to a Masters course upon successful completion of the Diploma course Masters programs usually last one year full-time or two years part-time, or sometimes two years full-time. For a master the most common entry requirement is a good quality Bachelor degree with Honours degree. Most Masters degrees are designated as MSc (Master of Science), depending on the subject Short Master degrees require normally 1 or 2 years fulltime studies (mainly the 90 and sometimes the 120 ECTS credits) after a Bachelor. The 2-year programmes may include a major dissertation or thesis and involve significant amounts of research.'' Specific view provided by Theiere partner *… I am not aware of any moves at this University to change the basic structure and length of the study programmes for its various awards …*
	Other specific view provided by Theiere partner *… As far as the U.K. is concerned, I am sure nothing seems to be going on with respect to the 3-5-8 programme. Indeed, many academics have not heard of it. Our engineering courses have just gone to a 4 year basis for a masters and we have always operated a (nominal) 3 year Ph.D. So we are on a 4-7 scheme. The government has tried to introduce a 2 year 'Foundation Degree' which is for poorly qualified students.* *But no-one is quite sure what to do with them once they are qualified and it does not seem popular. I doubt if we would let them into a second year. so they would be on a 2-6-9 course. I don't think many of them will be on a level for a Ph.D. though.* *The 3-5 -8 scheme is not being discussed publically as far as I know. There is a new scheme for our 'A' level students, which is designed to broaden their education. I suspect that this will result in students not being sufficiently prepared to start an engineering or science degree and so we may end up with a first year being taught what they used to learn at school and then the degree ending at what is now the second year. To do a Masters will need the present 3rd and 4th years. Then a Ph.D. will be after that. This equals a 3-5-8 system…*
	Other specific view provided by Theiere partner *…Here is my understanding of the UK system. We currently have, at undergraduate level, Bachelor of Engineering and Bachelor of Science programmes that last three years typically. This is a good start for the 3,5,8 model. We also have a Master of Engineering programme which is 4 years long starting at the same point as the Bachelor programmes. This 4 year programme is classified by the Government (at the moment at least) as a Masters programme and clearly does not fit the 3,5,8 model. A conventional Masters level programme typically lasts 1 year and can be taken by students with a Bachelor degree (or a Masters if it is in a different subject). Postgraduate studies are 3 years. So, in summary, at the 3 end - the Bachelor degrees fit well. At the 8 end, the 3 year Post-grad study also fits. In the middle the picture is less compatible and the nearest I think we offer is a 3,4,7 model at present…*

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4. Proposed Coordinated Structure for a Curriculum for a 3 years (180 ECTS) Bachelor degree in Electrical Engineering

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4.1. Introduction

The proposed coordinated structure for a Curriculum in Electrical Engineering has the objective of preparing professionals who will be able to analyse, specify, design, industrialise, commercialise and use products and services in Electricity, Electronics and Information Technologies.

It was decided that this Curriculum at Bachelor degree (3 years – 180 ECTS) would present a common structure with the following components and relative weights (measured in ECTS –European Credits Transfer System):

- Basics of Engineering (54 ECTS)
- Basics of Electrical Engineering (48 ECTS)
- Specialisation courses (48 ECTS)
- Project (12 ECTS)
- General courses or non-technical skills (18 ECTS)

Four specialisation areas were considered:

- Telecommunications,
- Electronics,
- Power Systems,
- Automation and Control.

This coordinated structure presents a strong common curriculum and only courses presented under the framework of “Specialisation courses” are different from area to area. Also, the final project is dedicated to each specialisation.

A strong base in scientific areas is included to underpin the knowledge needed in specialisations and to develop the reasoning required in the analysis and resolution of engineering problems.

A strong common base in the fundamentals in Electrical Engineering will allow the graduates to develop their skills as their discipline evolves and their specialisation courses will give the ability to enter directly to work market as a graduate in Electrical Engineering.

This curriculum can be complemented by a follow-up study which will allow a Master degree (more another 120 ECTS) in Electrical Engineering to be obtained. This will re-enforce the components of Bachelor degree and will include a higher weight for specialisation courses, complementary skills and project.

4.2. Coordinated Structure

Basics of Engineering (54 ECTS)

- Physics: mechanics, thermodynamics, optics, electromagnetism; 18
- Mathematics: Algebra, calculus, analysis 18
- Chemistry: material science, material properties, 6
- Programming language, Algorithms, Data structure 12

Basics of Electrical Engineering (48 ECTS)

- Digital and analogue circuits: combinatorial, sequential, flip-flop, passive and active circuits, filters, amplifiers, signal generation 12
- Signal Theory and Control (Laplace transform, Fourrier transform, Z-transform, etc, discrete and continuous systems, control) 12
- Power systems: transformer, electrical machines, basis of power production, transmission, distribution, power devices 6
- Computer architecture, Hardware peripheral, laboratory 6
- Engineering Measurement, Data Acquisitions 6
- Wave propagation, transmission media 6

Specialisation courses, 48 ECTS

48 ECTS for courses are dedicated for each specialisation area. A list for each specialisation area is presented in section 3.

Project on "name of the specialisation area" (12 ECTS)

Project or training in laboratory or in company 12

General education, Non-Technical Skills (18 ECTS)

- Foreign languages or free courses
- Management, business, project management

Others subjects referred:

- Communication skills: Report writing, presentation skills
- Business leadership and Project management
- Environmental issues and industrial laws
- Micro- and macroeconomics
- Scientific methodology

4.3. Courses from each Specialisation Areas

4.3.1 Telecommunications Specialisation Area (48 ECTS)

Core Specialist Courses in Telecommunications (30 ECTS)

- Advanced Analogue Electronics (filter design, PLLs, Mixers)
- Information & Communication (Shannon theorem, concept of information, advanced modulation)
- Digital Signal Processing
- Networks (network configuration& architecture, routing)
- Communications Systems (satellite systems, wireless systems)

Specialist Option I – Computer Communications (18 ECTS)

- Advanced programming (object oriented programming)
- Networks (protocols, data transmission, computer networks)
- Computer Systems (real-time systems, software engineering)

Specialist Option II – Communication Systems (18 ECTS)

- RF & Microwaves (wave propagation & antennas, waveguides. RF & microwave devices)
- Optical Communications (transmitters, receivers, optical fibres, WDM, Systems)
- Communication Systems (circuits, components, sub-systems and system design)

4.3.2 Electronics Specialisation Area (48 ECTS)

Core Specialist Courses in Electronics (30 ECTS)

- Digital and analogue circuits II: deepening, modelling, simulation 12
- Components (physic of semiconductor, technology) 12
- Microprocessors 6

Elective in Electronics (18 ECTS): choice of 3 from(some examples):

- Microwaves: propagation, antennas
- Opto-electronics
- Microelectronics
- Sensors and actuators
- Instrumentation (data acquisition, interfacing)
- Power electronics: commands- choppers, inverters, energy
- Analogue and digital communications
- Network initiation

4.3.3 Power System Specialisation Area (48 ECTS)

Core Specialist Courses in Power Systems (30 ECTS)

- Power Transmission and Distribution
- Power Network Analysis
- Electric Installations Project
- Electrical Machines
- Power Electronics

Specialist Option I - Power Transmission and Distribution (18 ECTS)

- Electric Energy Production
- Power Network Dynamics
- Protections and Switchgears

Specialist Option II - Power Electronics and Electric Machines (18 ECTS)

- Electric Drives
- Power Electronics II
- Industrial Automation

Other courses referred:

- Electric Energy Markets
- Renewable Energies
- Electrical Drives Control and Applications
- Electric Traction

4.3.4 Automation and Control Specialisation Area (48 ECTS)

Core Specialist Courses in Automation and Control (30 ECTS)

- Advanced Control
- Computer systems, single microcomputers
- Modelling and system theory
- Digital and analogue control systems
- Programmable logic controllers
- Sensors and actuators
- Computer networks and communication

Elective courses in Automation and Control Specialisation Area (18 ECTS), choice from elective courses (some examples):

- Industrial Control
- Instrumentation (interfacing, protocols, data acquisition)
- Software design
- Industrial database management
- Process Visualisation
- Computer vision
- Basics of artificial intelligence
- Scheduling and logistics

2nd part

Overview per country

1. AT: Österreich (Austria)

Coordinating author: Christian MAGELE (Technische Universität Graz, magele@igte.tu-graz.ac.at)
Review: José Vincente BENLLOCH (EAEEIE, Universidad Politécnica de Valencia, España)

1.1. General information

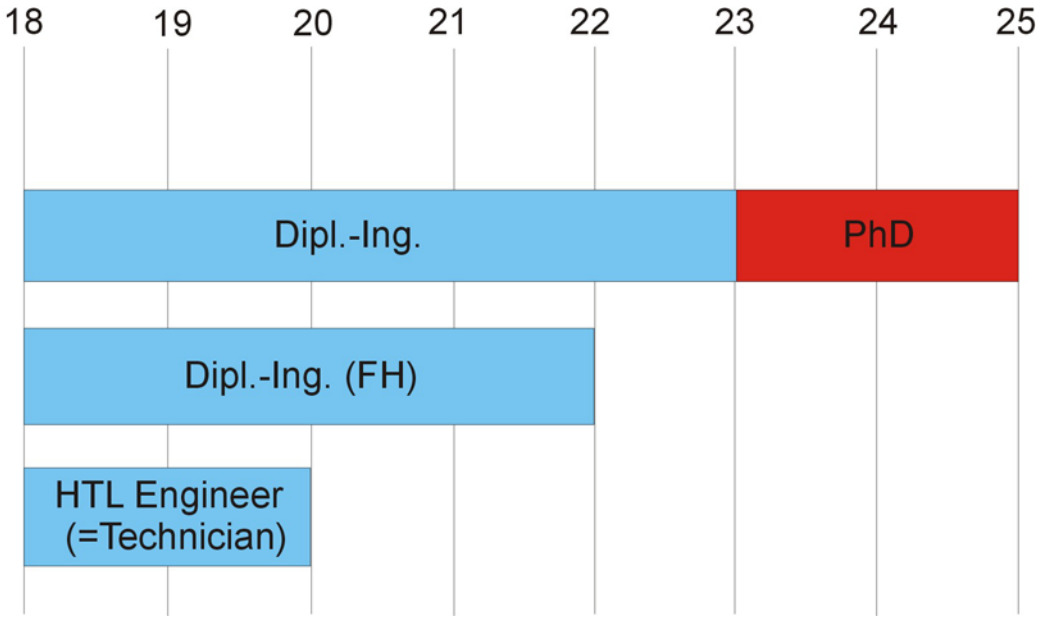

Figure 1.1: Austrian Higher Education System in EIE disciplines

To enter University in general one has to have passed the "*Matura*", which is the final examination of all secondary schools (*Gymnasium)* at the age of 18, Technical High School (*Höhere Technische Lehranstalt*) the age of 19, Commercial High School (*Handelsakademie*) at the age of 19.

The Austrian higher education has 2 kinds of systems, there are "*Fachhochschulen* (in general 4 years), which offer a job oriented higher education and there are universities, which offer a scientifically oriented education. At the moment, Austria has 22 different universities. (http://www.oead.ac.at/STUDYOE/Unis/Default.htm), but in fact there are only two universities, *Technische Universität Wien* (Vienna University of Technology) and *Technische Universität Graz* (Graz University of Technology), where there exists a faculty entitled "Faculty of Electrical Engineering and Information Technology" (Vienna: http://info.tuwien.ac.at/et/english/ ; Graz: https://online.tu-graz.ac.at:445/start445.html). These universities cover a large spectrum of topics in electrical engineering and information technologies.

Besides that, there are several departments located at other universities in Austria (e.g. *Universität Linz*), which deal with specific topics of electrical engineering and/or information technology.

1.1.1 Electrical and Information Engineering in Austria, boundaries of the field of study

Actually, both faculties of Electrical Engineering (Vienna and Graz) have recently added “and Information Technology” to their names (= *Fakultät für Elektrotechnik und Informationstechnik*). So EIE basically means both the classical part of Electrical Engineering (Electrical Drives and Machines, Power Systems and Energy Economics, Electrical Measurements, Fundamentals and Theory of Electrical Engineering, Automation and Control, Electronics, Communication Networks, …) and the more recent part like Computer Technology or Technical Informatics and “Electrical and Sound Engineering”.

1.1.2 Content, degrees and accreditations

1.1.2.1 Level of University curricula

Right now, the contents is defined by so called “*Studienkommissionen*” (Full Professors, Associated Professors, Students) set up by the respective faculties.

You can find the Vienna curriculum here (http://info.tuwien.ac.at/et/german/Semestereinteilung2001.html) and the Graz curriculum here (http://www.zv.TUGraz.at/studabt/studienplaene_01_02/710.pdf).

Basically, both in Vienna and Graz, the Electrical Engineering studies (10 semesters) are divided into 3 parts:

“1. *Studienabschnitt* (2 semesters) , 2. *Studienabschnitt* (4 semesters) , 3. *Studienabschnitt* (4 semesters)”. The first two parts provide the student with the necessary basics, while in the third part the student can put more emphasis on her/his special preferences. Nevertheless, one has to subscribe to one of the following areas of concentration (“*Studienzweig*”): Vienna: Power systems, Automation and Control, Telecommunications, Computer Technology, Microelectronics; Graz: Power systems, Automation and Control, Information Technology, Biomedical Engineering.

Additionally there is a curriculum called “Electrical and Sound Engineering”, which can be studied only at Graz University of Technology.

1.1.2.2 Level of *Fachhochschule* curricula

Recently an enormous number of courses in *Fachhochschulen* have been established, among them several dealing with Electrical Engineering and Information Technology.

1.1.2.3 Level of the technician curricula

After the age of 15 a pupil can decide to enter a Technical High School (*Höhere technische Lehranstalt*) and complete there her/his secondary education at the age of 19. She/he finishes with the “HTL-Engineer” degree. The same degree can be achieved (after having done any secondary school) by completing two years of college. In my opinion this is very similar to the standard definition of a technician.

1.1.3 Implementation of the Bologna-BMD system in Austria

The government has stated, that the Bologna-BMD system has to be implemented in the near future (next 3 to 5 years?). Right now, the curricular committees are discussing this issue (see also §1.1.2).

1.2. Figures on the weight of EIE in Austria

Universities:

Graz University of Technology: approx. 1500 Students
Vienna University of Technology: approx. 2000 Students

Fachhochschulen:

Technikum Wien (http://www.technikum-wien.at): approx. 300 Students
Technikum Kärnten (http://www.fh-kaernten.ac.at): approx. 350 Students
Technikum Kapfenberg (http://www.fh-joanneum.at/): approx. 300 Students

Höhere technische Lehranstalten:

There are 25 schools offering a Technician education in Electrical Engineering and Information Technology in a regular way (pupils from 15-19 years). In general, they also offer 2 year courses (called College) for those, who have already finished their secondary education, which means that they have received their "*Matura*" degree.

1.3. Degrees in EIE in Austria

Right now, in all university EIE curricula, we have a 5+2 system (5 years of "*Diplomstudium*", ends with the "*Diplom Ingenieur*" degree, which is equivalent to a Master degree; 2 years of "*Doktoratsstudium*", ends with the "*Dr. techn*." degree, which is equivalent to a PhD degree).

Nevertheless, there is a reshaping (discussion) of the EIE curricula going on both in Vienna and Graz. Both universities are tending towards a 3-5-(7 or 8) bachelor-master-PhD system.

In the "*Fachhochschule*", there is a 4 year system, the student ends up with Dipl.-Ing. (FH) degree. After having passed the "*Fachhochschule*", a student can apply to continue in a master course, if available for the chosen subject, and finally register for a PhD. So, a complete "*Fachhochschule*" career turns out to be a 4+2+2 system.

1.3.1 Before bachelor (HTL Engineer)

Technician level in Information Technology
Technician level in Telecommunication/Information Networks/Computer Technology
Technician level in Automatic Control
Technician level in Control Engineering
Technician level in Electronics
Technician level in Industrial Electronics/Electrical Engineering
Technician level in Biomedical Engineering
Technician level in Technical Informatics

1.3.2 Bachelor level

No Bachelor system installed yet.

1.3.3 Intermediate level, between bachelor and master (*Fachhochschule*)

Dipl. Ing. (FH) in Electronics: Basics of Electrical Engineering/Physics 20%, Electronics 40%, Economic subjects 20%, subjects of concentration 20%.

Dipl. Ing. (FH) in Telematics/Networks: Basics of Electrical Engineering/Physics 20%, Telecommunication/Electronics 25%, Special Networks (communication, automation) 20%, Economic subjects/Project management 20%, subjects of concentration 15%.

Dipl. Ing. (FH) in Electronic Engineering: Basics of Mathematics/Physics 20%, Electrical Engineering/Electronics 30%, Informatics 20%, Economic subjects/Project management 20%, subjects of concentration 10%.

1.3.4 Master level (= University Level)

Dipl. – Ing. in Electrical Engineering: Mathematics,Physics 10%, Electrical Engineering and Information Technology (general subjects) 40%,
Areas of concentration are: Power systems, Automation and Control, Telecommunications, Computer Technology, Microelectronics, Information Technology, Biomedical Engineering, economic subjects (40% each)
Soft Skills 10%

Dipl. – Ing. in Telematics: Electrical Engineering 30%, Informatics 30%, Mathematics and Algorithms 20%, Soft Skills 20%

Dipl. – Ing. in Electrical and Sound Engineering: Electrical Engineering 40% (Basics, Electronics, Automation Control,….), Sound Engineering, Musical and Art Education 40%, Soft Skills 20 %

1.4. References

The information given in this monograph is based on the following documents and web links:
http://www.oead.ac.at/STUDYOE/Unis/Default.htm
http://info.tuwien.ac.at/et/german/Semestereinteilung2001.html
http://www.zv.TUGraz.at/studabt/studienplaene_01_02/710.pdf.

2. BE: België - Belgique - Belgien (Belgium)

Coordinating author: Raf CATHOOR (EAEEIE, Karel de Grote Hogeschool, raf.catthoor@kdg.be)
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2.1. General information

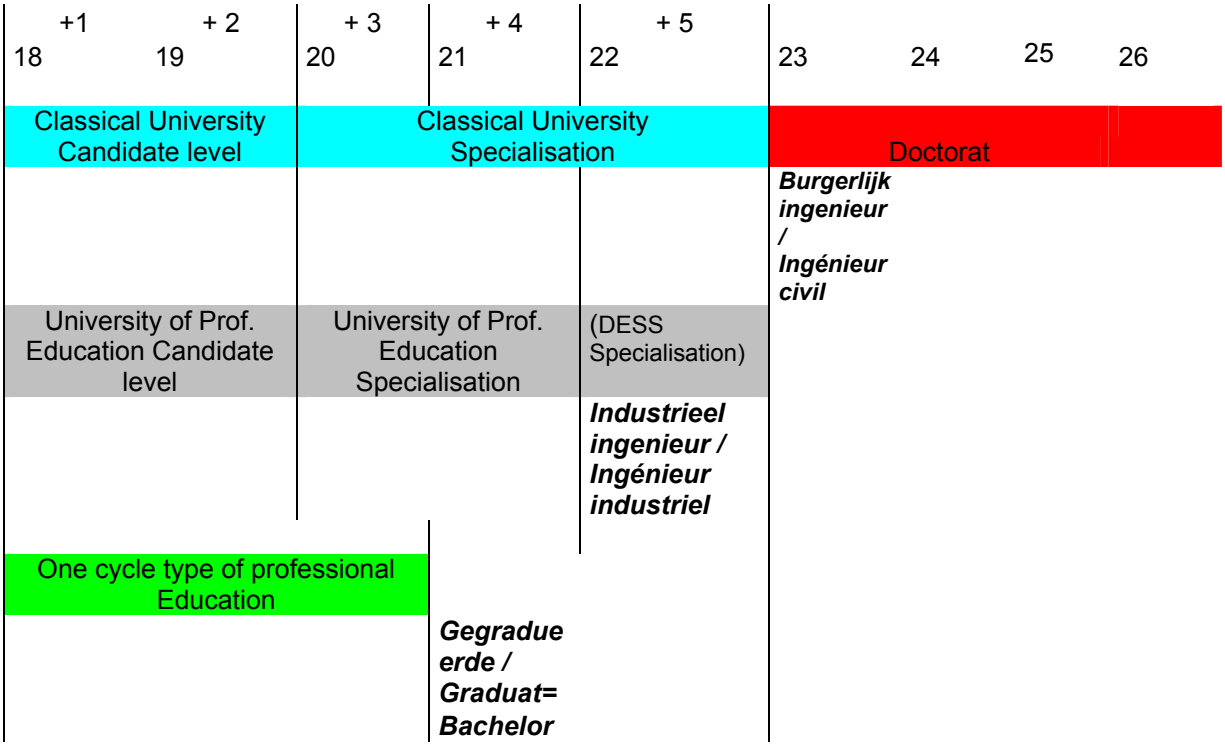


Figure 2.1: Belgian Higher Education System in EIE disciplines

Capital: Brussels. Population (thousands): 10,500

In 1993, Belgium became a federation of three communities, each with their own legislative council and government: the Flemish speaking, the French speaking and the German speaking community. The three communities have autonomy in education.

2.1.1 Electrical and Information Engineering in Belgium, boundaries of the field of study

The Belgian higher education has 2 types of universities:

1. The "Classical" Universities, (Universities of academic education) which offer a scientifically oriented education (duration 4 or 5 years, depending on the faculty).

2. The Universities of Professional Education, called "*Hogescholen*" (Flemish community) or "*Haute Ecoles*" (French community). They offer a more job oriented higher education.
To obtain an academic level, the duration of the studies is 4 years: 2 cycles of 2 years. It is now called the "industrial engineering" programme.
All those universities offer several 3 year bachelor programmes as well. This is a one-cycle education, which is mainly aimed at vocational training. Only the institutions offering a two-cycle education are considered to be at academic level.

In the classical Universities, EIE is part of the faculty of Electrical – Electronics Engineering (5 year study programme). Computer Technology and informatics is also taught in the faculty of Science (4 year study programme).

In the Universities of Professional Education, all EIE programmes are in one faculty. This means that Computer Technology or Technical Informatics is taught in the faculty of Electrical – Electronics Engineering, together with the study fields Electronics, Communication Networks, Multimedia, Chip design, … Only some universities of professional education have received the right to organise directly a field of study of Applied Informatics. This is true for the 3 year one-cycle programme, as well as for the two-cycle industrial engineering programme.

In the 4 year industrial engineering programme, the traditional part of electrical engineering now belongs to the faculty of mechanical engineering: Electrical Drives and Machines, Power Systems and Energy Economics, Electrical Measurements, Fundamentals and Theory of Electrical Engineering, Automation and Control.

In the faculty of Electrical – Electronics Engineering, there are two specialisations in the third and fourth year: electronic design techniques, and ICT. In Flanders, in the first option there are 355 students, and in the second option 600 students (3rd plus 4th year).

In general, engineering studies are less popular than 10 years ago. Today, students are mainly interested in Informatics, Multimedia, web design, ... They have less interest in electricity and electronic design courses.

2.1.2 Content, degrees and accreditations

The content is defined by the law giving a list of obligatory courses. Each institution has the possibility to add a serial of specific courses to this list. EIE education profiles and the professional job profiles are defined in cooperation with representatives from the industry.

2.1.3 Implementation of the Bologna-BMD system in Belgium

There is a reshaping discussion of the EIE curricula going on both in Flanders and Wallonia.

The Classical Universities are tending towards a 3-5-8 (or more years) bachelor-master-PhD system.
The master title will be “master of science in engineering” (Dutch: *master of science in de toegepaste wetenschappen*; French: *master of science dans les sciences appliquées*).
The bachelor title will be “bachelor of science in engineering“ (Dutch: *bachelor of science in de toegepaste wetenschappen*; French: *bachelor of science dans les sciences appliquées*).
The faculties will keep the old name “faculty of applied science” (Dutch: *faculteit toegepaste wetenschappen*; French: *faculté des sciences appliquées*).

The 4 year programme (2 cycles of 2 years) of the Universities of Professional Education will be transformed in a 3+1 bachelor-master system, or in a 3+2 bachelor-master system.
The master title will probably be “master in industrial sciences” (Dutch: *master in de industriële wetenschappen*; French: *master dans les sciences industrielles*).
The bachelor title will probably be “bachelor in industrial sciences“.
(Dutch: *bachelor in de industriële wetenschappen*; French: *bachelor dans les sciences industrielles*).
The master studies must apply for accreditation. An external, international body will give accreditation.

In the Flemish community, all Universities of Professional Education will transform their four year programmes into a 3+1 bachelor-master system. One of the reasons is that there is not enough money to convert them to a five year programme. The new title will be “master in engineering”, the faculties will be called “faculty of industrial sciences” (Dutch: *faculteit industriële wetenschappen*; French: *faculté des sciences industrielles*).
These universities will have to associate with a classical university in order to obtain accreditation for their master studies. But the latter is only one of the conditions for obtaining an accreditation for their master programme. Most important is the requirement to work out scientific research activities, which must be significant and must be organised intra muros. Some engineering schools are associating with a university without a faculty of engineering!
The Flemish minister of education would like to start with the new programmes in September 2004. This means that the first bachelor degrees will be given in 2008. The new education development plans of the institutes should be submitted by the end of September 2003.

In the French community, there is not yet an implementation of the Bologna-BMD system.
One of the ideas is to extend the studies of industrial engineering to 5 years; the industrial stage and the final work will be done during this 5th year. This community believes that it will be hard to obtain accreditation for a one year master programme.

The 3 year programme of the Universities of Professional Education will automatically be transformed into a bachelor. This bachelor degree is different from the previous one, and a minimum of one bridge-year will be required for having access to master studies.

2.2. Figures on the weight of EIE in Belgium

In the Universities of Professional Education, one cycle type, the number of EIE students is about 10 % of the total population.
In the Universities of Professional Education, two cycle type, the number of EIE students is about 8,5 % of the total population.
In the Universities, the number of EIE students is about 6 % of the total population.

(Data for Flanders, 2001-2002)
http://www.ond.vlaanderen.be/hoger_onderwijs/online_statistiekennieuwSTART.htm

2.3. Degrees in EIE in Belgium

All students who hold an upper secondary education certificate have access to higher education.
Belgium has a three tier higher education system:

The **Universities of Professional Education** deliver a secondary school ("sec. sch.") +3 diploma for their one-cycle education, which is not of academic level. The secondary school +3 diploma is a bachelor degree, e.g. bachelor in automatic control, bachelor in electronics, bachelor in telecommunications....

The **Universities of Professional Education** deliver a "sec. sch." +4 diploma for their two-cycle education. This diploma is of academic level. The "sec. sch."+4 system ends with the diploma of “Industrial engineering”, e.g. industrial engineering in electronics.

Classical Universities with EIE curricula have in general a "sec. sch." +5 system. It ends with the “*Burgerlijk Engineer*” (Flemish community) or “*Ingénieur civil*” (French community) degree, which is equivalent to a Master degree, e.g. master in electronics, master in electricity, …
Only these universities organise an admission exam.
Computer Technology and Informatics is also a final degree in the faculty of Science, which is now a 4 year study programme.

2.3.1 Bachelor level (Gegraduerde/Graduat)

Bachelor in Electronics-ICT
Bachelor in Applied informatics.
Bachelor in Multimedia and Communication Technology
Bachelor in Informatics

2.3.2 Intermediate level, between bachelor and master (*Industrieel ingenieur/Ingénieur industriel*)

Industrial Engineering in Electronics specialisation Design Techniques
Industrial Engineering in Electronics specialisation Information and Communication Techniques

2.3.3 Master level (Burgerlijk ingenieur/Ingénieur civil)

Master in Electrotechnics, specialisation physical electronics
Master in Electrotechnics, specialisation ICT-micro-electronics
Master in Electrotechnics, specialisation ICT-multimedia and signal processing
Master in Electrotechnics, specialisation ICT-telecommunication and telematics
Master in Informatics
Master in Computer science (4 years)

2.4. References

The information given in this monograph is based on the following documents and web links:
Education in the Flemish community:
http://www.ond.vlaanderen.be/

Education in the French community:
http://www.agers.cfwb.be/
http://www.restode.cfwb.be

Société Européenne pour la Formation des Ingénieurs (SEFI):
http://www.sefi.be

3. BG: България (Bulgaria)

Coordinating author. Dr Silvia STEFANOVA (EAEEIE, Rousse University, silva@ru.acad.bg)
Other contributors: Dimiter DIMITROV (University of Sofia, dcd@vmei.acad.bg), George GEORGIEV (EAEEIE, Rousse University, gsg@ru.acad.bg)
Review: Fernando. MACIEL-BARBOSA (EAEEIE, Universidade do Porto, Portugal)

3.1. General information

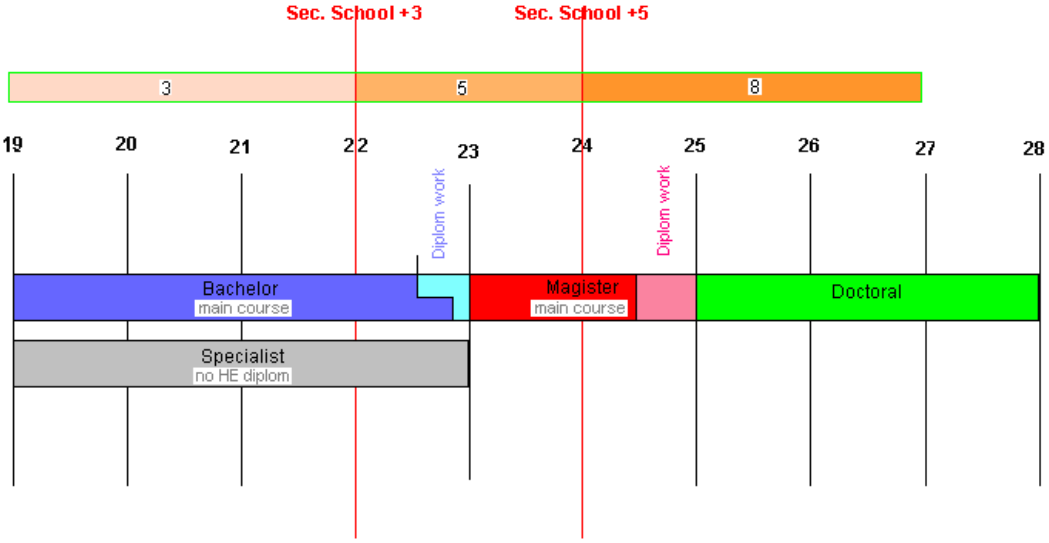


Figure 3.1: Bulgarian Higher Education System in EIE disciplines

In Bulgaria the curriculum is slightly different at each University. The basic courses are mandatory, but there are some courses that are optional. The Academic council of each University validates the curriculum in connection with the Academic Autonomy of the Bulgarian Universities.

3.1.1 Electrical and Information Engineering in Bulgaria, boundaries of the field of study

List of general Education Areas and Professional Directions and ***EIE Education Areas and Professional Directions***

The List of general Education Areas and Professional Direction is established by the Bulgarian government. The Classification of Higher Education Areas and Professional Directions is prepared on the basis of Bulgarian Experience in Higher Education and is consistent with appropriate Education Areas and Professional Directions in the world.

Classification **Of Higher Education Areas and Professional Directions**			
Code	Higher Education Area	Code	Professional Direction
4	Natural Sciences, Mathematics and Informatics	4.6	Informatics and Computer Science
5	Technical Science	***5.2*** ***5.3*** ***5.4***	***Electrical Engineering, Electronics and automatics*** ***Communication and computer techniques*** ***Power engineering and electrical equipment***

The code 4.6. is removed because that speciality is not classified as engineering yet.

3.1.2 Content, degrees and accreditations

The Government defines the pedagogical content of the degrees. It defines the curriculum and the list of the compulsory subjects in general for each of the above-mentioned specialities for the period of education (semester shared). In this frame the Academic Council of each University independently (principle academic autonomy) determines and votes the teaching programmes for each speciality.

3.1.3 Implementation of the Bologna-BMD system in Bulgaria

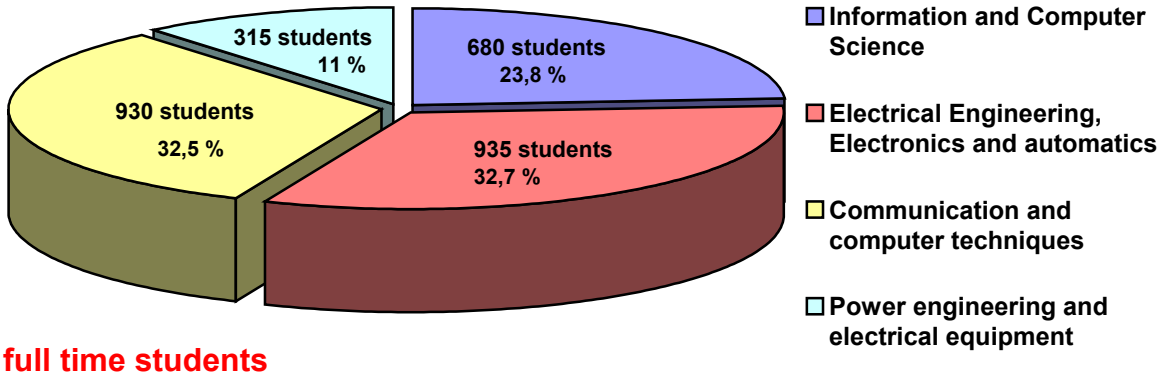
The Bologna-BMD system is now available in Bulgaria. The higher education system has been structured in three levels, bachelor-master/magister-doctor, since April 2002.

3.2. Figures on the weight of EIE in Bulgaria

Educational Institution, Teaching Staff and Students					
	1996/97	1997/98	1998/99	1999/2000	2000/2001
Institutions	42	42	42	41	41
Teaching Staff	23285	19416	22072	24368	21162
Students	235701	234182	245237	239769	227223
Doctors	2075	2558	2775	3091	3414

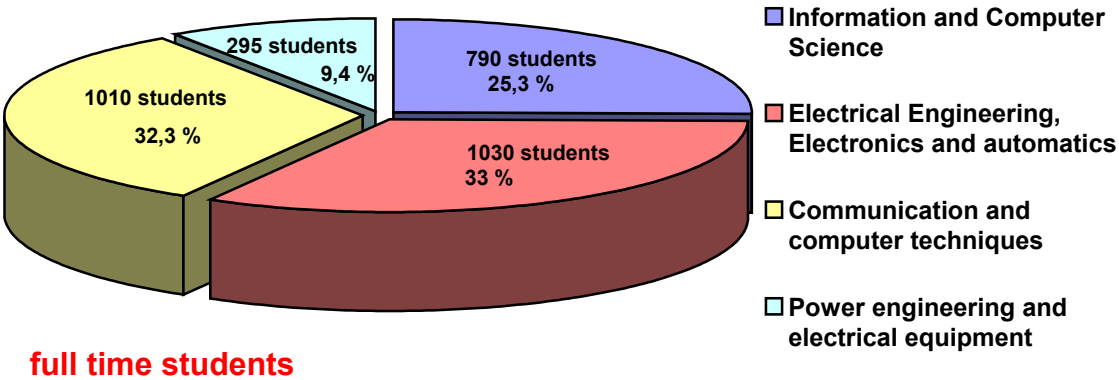
Distribution of the students in EIE specialities

2001/2002



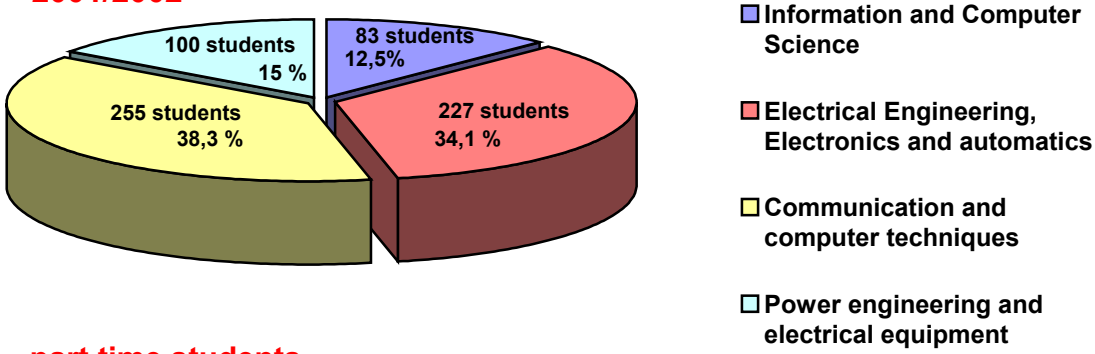
full time students

2002/2003



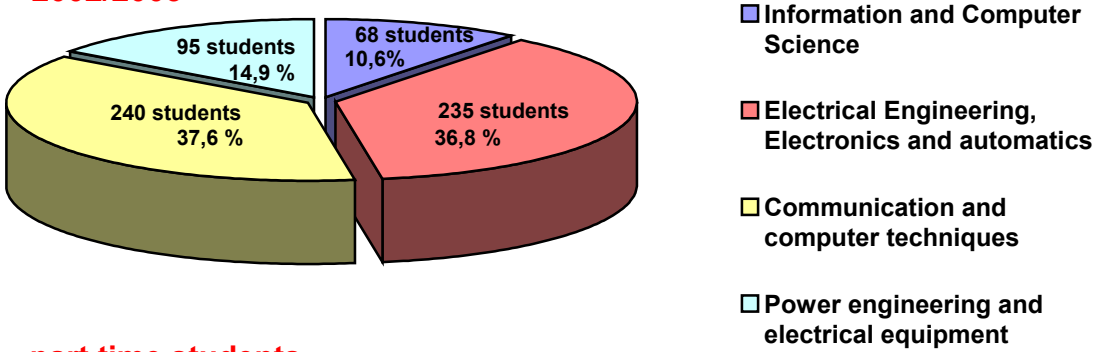
full time students

2001/2002



part time students

2002/2003



part time students

N	High Education Schools 2002/03	Teaching form M.sc+ Bach		EIE Students M.sc+ Bach		
		Full time	Part time	Code	Full time	Part time
1	University of Sofia “Sv.Kliment Ohridski”	4170	740	4.6	290	
2	“Paisij Hilendarski”University of Plovdiv	1370	370	4.6	80	20
3	“Cyril i Methodius”University of Veliko Tarnovo	1350	370	4.6	40	
4	University of Shoumen “ Ep.Konstantin Preslavski	870	255	4.6	75	
5	South-West University “Neofit Rilski”, Blagoevgrad	1350	120	4.6 5.3	50 40	
6	University of Rousse “Angel Kantchev”	935	230	4.6 5.2 5.3	25 110 120	25 35 30
7	Technical University – Sofia	1840	370	4.6 5.2 5.3 5.4	20 420 430 140	 90 70 40
9	Technical University – Sofia, branch Plovdiv	310	25	5.2 5.3	80 80	 25
9	Technical University – Sofia, branch Sliven	100	45	5.2 5.4	40 30	15 15
10	Technical University – Varna	875	110	5.2 5.3 5.4	170 190 75	20 30 20
11	Technical University – Gabrovo	570	200	5.2 5.3 5.4	90 110 50	20 45 20
12	University of Mining and Geology- Sofia	360	135	5.2	60	35
13	Chemical Technology & Metallurgy University-Sofia	525	120	5.2	60	20
14	High School of Transport “Todor Kableshkov”, Sofia	130	70	5.3	30	20
15	University of National and World Economy, Sofia	2200	600	4.6	80	
16	University of Economics, Varna	1335	350	4.6	80	23
17	Academy of Economics “D.Cenov”, Svishtov	1030	400	4.6	50	
18	Higher School of Transport “T.Kableshkov”-Sofia	130	70	5.3	30	20
				4.6 5.2 5.3 5.4	790 1030 1010 295	68 235 240 95
	Total	19470	4253		3125	638

3.3. Degrees in EIE in Bulgaria

The Diplomas in EIE are defined by two elements: *the concrete title* and **the direction**:

3.3.1 Specialist level

- **Specialist** - 3 years after the secondary school for full-time students and 3,5 years for part-time students;
  1) *Informatik*, **Informatics and Computer Science** (code 4.6), Natural Sciences, Mathematics and Informatics (code 4). => this degree is not, exactly, an "engineering" degree but is close to the border of "Electrical and Information Engineering"
  2) *Electronics Technic Engineer*, Electrical Engineering, **Electronics and automatics** (5.2), **Communication and computer techniques** (5.3), Technical Science (5)
  3) *Electrical Engineer*, **Electrical Engineering**, Electronics and automatics (5.2), **Power engineering and electrical equipment** (5.4), Technical Science (5)

3.3.2 Bachelor level

- **Bachelo**r – 4 years after the secondary school for full-time students and 5 years for part-time students;
  4) *Informatik*, **Informatics and Computer Science** (code 4.6), Natural Sciences, Mathematics and Informatics (code 4). => this degree is not, exactly, an "engineering" degree but is close to the border of "Electrical and Information Engineering"
  5) *Electronics Technic Engineer*, Electrical Engineering, **Electronics and automatics** (5.2), **Communication and computer techniques** (5.3), Technical Science (5)
  6) *Electrical Engineer*, **Electrical Engineering**, Electronics and automatics (5.2), **Power engineering and electrical equipment** (5.4), Technical Science (5)

Distribution of the general areas in EIE training for Bachelors

Title and code of the speciality in EIE **Keywords**	*5.2.1. (PSRE)*	*5.2.2. (E)*	*5.2.3. (AICT)*	*5.3.1. (CST)*	*5.3.2. (CTT)*
Basic Training					
Mathematics/ Physics	11 %	12 %	12 %	12 %	12 %
Electrotechniques/ Instrumentation& Measurement	7 %	10 %	12 %	6 %	8 %
Electronics	4 %	38 %	7 %	12 %	10 %
Computers/ Informatics	3 %	9 %	24 %	35 %	11 %
Networks				4 %	9 %
Control Engineering		6 %	24 %		2 %
Communication, radio and video systems					29 %
Power Systems	40 %				
Mechanical Technology/ Systems	9 %				
Additional Training					
Foreign Language	4 %	4 %	4 %	4 %	4 %
Projects	2 %	1 %	4 %	8 %	1 %
Industrial Practice	3 %	4 %	4 %	3 %	4 %
Technical Documentation	1 %	2 %	2 %	3 %	3 %
Economics/ Management	1 %	5 %	3 %	3 %	2 %

Codes and abbreviations of the specialities:

5.2.1.Power Supply and Power Equipment (PSRE)
5.2.2.Electronics (E)
5.2.3.Automatics and Information Control Techniques (AICT)
5.3.1.Computer Systems and Technologies (CST)
5.3.2.Communication Technique and Technologies (CTT)

3.3.3 Master/Magister level

- **Master/Magister** – no less than 5 years after the secondary school for the non-bachelor specialities and for full-time students, 3 semesters after the bachelor level for full-time students or 4 semesters for part-time students);
  7) *Informatik*, **Informatics and Computer Science** (code 4.6), Natural Sciences, Mathematics and Informatics (code 4). => this degree is not, exactly, an "engineering" degree but is close to the border of "Electrical and Information Engineering"
  8) *Electronics Technic Engineer*, Electrical Engineering, **Electronics and automatics** (5.2), **Communication and computer techniques** (5.3), Technical Science (5)
  9) *Electrical Engineer*, **Electrical Engineering**, Electronics and automatics (5.2), **Power engineering and electrical equipment** (5.4), Technical Science (5)

3.4. References

The information given in this monograph is based on the following documents and web links:

1. Higher Education, 2001, vol II, Ministry of Education and Sciences, under the edition of Prof. D. Dimitrov;
2. Statute No 86 from 12th of March 1997 for the validation of the government register of the education-qualification degrees in Higher Schools of Bulgaria Republic
3. Statistical Yearbook, 1998, 1999, 2000, 2001
4. Седмично издание АБВ, май 2002.

4. CZ: Česká republika (Czech Republic)

Coordinating author: Michal CHMELA (Brno University of Technology, chmela@feec.vutbr.cz)
Review: Cyril BURKLEY (EAEEIE, University of Limerick, Ireland)

4.1. General information

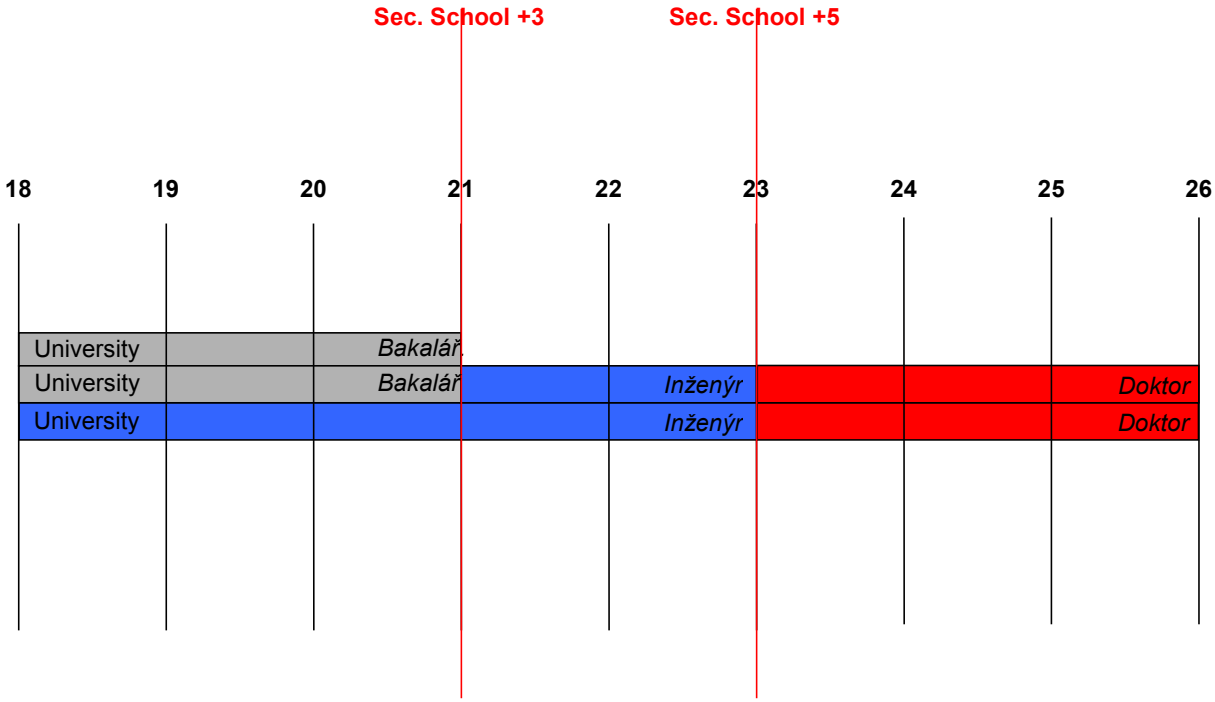


Figure 4.1: Czech Higher Education System in EIE disciplines

Higher education is provided by university type institutions ("*vysoká škola univerzitní*" in Czech language) and non-university type institutions ("*vysoká škola neuniverzitní*" in Czech language). The non-university higher education institutions are not divided into faculties and offer mainly bachelor study programmes. Higher education institutions of university type offer bachelor, master and doctoral study programmes. Higher education institutions offer courses in the humanities, social sciences, natural sciences, engineering, medicine and pharmacy, theology, as well as in economics, veterinary medicine, and agriculture, teacher training and arts. There are 45 higher education institutions: 24 public, 17 private and 4 state institutions. The majority of higher education institutions are public institutions. There are 6 higher education institutions in the field of EIE, all of them are public university type institutions. Public institutions are financed by the state budget by the Ministry of Education, Youth and Sports. The private higher education institutions could be partially financed by the state. In addition, the Czech higher education system includes 4 state higher education institutions. There are three military higher education institutions and a police academy. These institutions are financed by the Ministry of Defence and the Ministry of the Interior. All higher education institutions provide accredited study programmes which are assessed by the Accreditation Commission.

There are three university level studies:

- Bachelor studies *(Bc. = "Bakalář"):*

The standard length of study including practical training is at least three years and at most four years. According to the Higher Education Act there is no difference between bachelor

studies at university and non-university type institutions. The bachelor study programmes cover all main disciplines, except in medicine, veterinary medicine, pharmacy, architecture and law. It is conceived either as an independent course whose graduates are fully qualified for particular professions, or as the first stage of longer studies whose graduates can continue towards the magistr degree. This cycle leads to the academic degree of "*Bakalář*" (Bc.) or "*Bakalář umění*" (BcA.) in the field of arts which was introduced in January 1999. Students must sit for a final state examination, part of which is also the defence of the bachelor thesis.

- Master studies (Mgr. = "*Magistr*"):

The standard length of study is at least four and at most six years. Master study programmes may represent a continuation of bachelor study programmes; should this be the case, the standard length of study is at least two and at most three years. The master study programmes in the humanities, education and social sciences, natural sciences, pharmacy, theology, law and art last for five years and lead to the title of "*Magistr*" (Mgr). In economics, agriculture and chemistry, studies last for five years and lead to the academic degree of "*Inženýr*" (Ing.). In engineering, studies last between five and five-and-a-half years and also lead to the degree of "*Inženýr*" (Ing.). In architecture, veterinary medicine and medicine, studies last for six years. Graduates in medicine obtain the degree of "*Doktor medicíny*" (MUDr) and of "*Doktor veterinární medicíny*" (MVDr) in veterinary medicine. According to the 1998 Act, graduates of master programmes in architecture are awarded the title of "*Inženýr architekt*" (ing. arch.) and graduates in the arts the academic degree of "*Magistr umění*" (MgA). The new Act enables holders of the title of *magistr* to sit for a state examination in the same field and defend a dissertation to acquire the academic degree of Doktor followed by the name of the field "*Doktor práv*" (JUDr), "*Doktor filosofie*" (PhDr), "*Doktor přírodních věd*" (RNDr), "*Doktor farmacie*" (Phar.Dr.) and "*Doktor teologie*" (ThDr).

- Doctoral studies *(Dr. = "Doktor"):*

The standard length of study is three years. The third and highest level of higher education consists in studies for the doctorate which take place under the guidance of a tutor. The programme is aimed at scientific research and independent study. Holders of the master's degree may apply. Studies last for three years (four to five years part-time) and lead to the academic degree of "*Doktor*" (PhD) or "*Doktor teologie*" (Th.D.) in the field of theology. Studies end with the state doctorate examination and the defence of a dissertation.

4.1.1 Electrical and Information Engineering in Czech Republic, boundaries of the field of study

EIE in the Czech Republic covers the whole spectrum of electrical and information disciplines, i.e. instrumentation and measurement, control systems, robotics and automation, telecommunications, dielectrics and insulation, antennas and propagation, engineering in medicine and biology, power engineering, power electronics as well as information engineering. There is usually one common faculty for both electrical and information engineering, since 2002 there has been a special faculty for information engineering at Brno University of Technology and it is probable that the same will happen at the other universities.

4.1.2 Content, degrees and accreditations

Pedagogical content is proposed by each university. The proposal must be approved by the Ministry of Education, still there is no common programme at national level.

4.1.3 Implementation of the Bologna-BMD system in Czech Republic

The Bologna-BMD system has been implemented since the school year 2002/2003 at the following institutions:

- Faculty of Electrical Engineering and Communication and the Faculty of Information Technology of Brno University of Technology
- Faculty of Informatics of the Masaryk University Brno,
- Faculty of Electrical Engineering of the University of West Bohemia in Pilsen
- Faculty of Electrical Engineering of Czech Technical University in Prague

It will be implemented at the Faculty of Electrical Engineering and Informatics of the Technical University of Ostrava in the school year 2003/2004. The Department of Informatics of the University of Pardubice provides only bachelor level studies.

4.2. Figures on the weight of EIE in the Czech Republic

All the data below concerns the school year *2001-2002*. Detailed data for technical disciplines is available only for bachelor and master study level.

The total number of students in higher education institutions: 238 578

Bachelor and master studies
Total number of students: 219 514
Number of students in technical disciplines: 54 421
Number of students in EIE disciplines: 11 875

Total number of graduates: 28 657
Number of graduates in technical disciplines: 6279
Number of graduates in EIE disciplines: 1445

Doctoral studies
Total number of students: 19 064
Total number of graduates: 1 062

4.3. Degrees in EIE in the Czech Republic

- Bachelor (*Bakalář – Bc.*): three years of higher education studies after the end of secondary school).
- Master (*Inženýr – Ing.*): five years of university studies after the end of secondary school or – when the Bologna-BMD model is applied – two years of university studies after the end bachelor studies.
- Doctor (*Doktor – Ph.D.*): three years of university studies after the end of master studies.

4.3.1 Bachelor level

Standard length of studies is six semesters, which represents 180 credits (ECTS) with the following average distribution of subjects:
- fundamentals (mathematics, physics etc.): 35 %
- computer and information systems: 15 %
- specialized courses in a given EIE field: 40 %
- languages (mainly English and German): 5 %
- projects: 5 %

4.3.2 Master level

Standard length of studies is four semesters (358 model), which represents 120 credits (ECTS) with the following average distribution of subjects:
- fundamentals (mathematics, physics etc.): 7 %
- computer and information systems: 14 %
- specialized courses in a given EIE field: 60 %
- languages (mainly English and German): 7 %

- projects: 12 %

4.4. References

The information given in this monograph is based on the following documents and web links:

- http://www.msmt.cz/ (Ministry of Education, Youth and Sports)
- http://www.msmt.cz/Files/vysokeskoly/Legislativa/HigherEduAct.htm (Higher Education Act)
- http://www.csvs.cz/_en/ (Centre for Higher Education Studies)
- http://www.czso.cz (Czech Statistical Office)

5. DE: Deutschland (Germany)

Coordinating author: Otto RÖSCH (EAEEIE, Universität gesamthochschule Siegen, roesch@rst.e-technik.uni-siegen.de)
Other contributor: H. ROTH (Universität gesamthochschule Siegen, roth@rst.e-technik.uni-siegen.de)
Review: Jorge ESTEVES (EAEEIE, Instituto Superior Técnico, Lisboa, Portugal)

5.1. General information

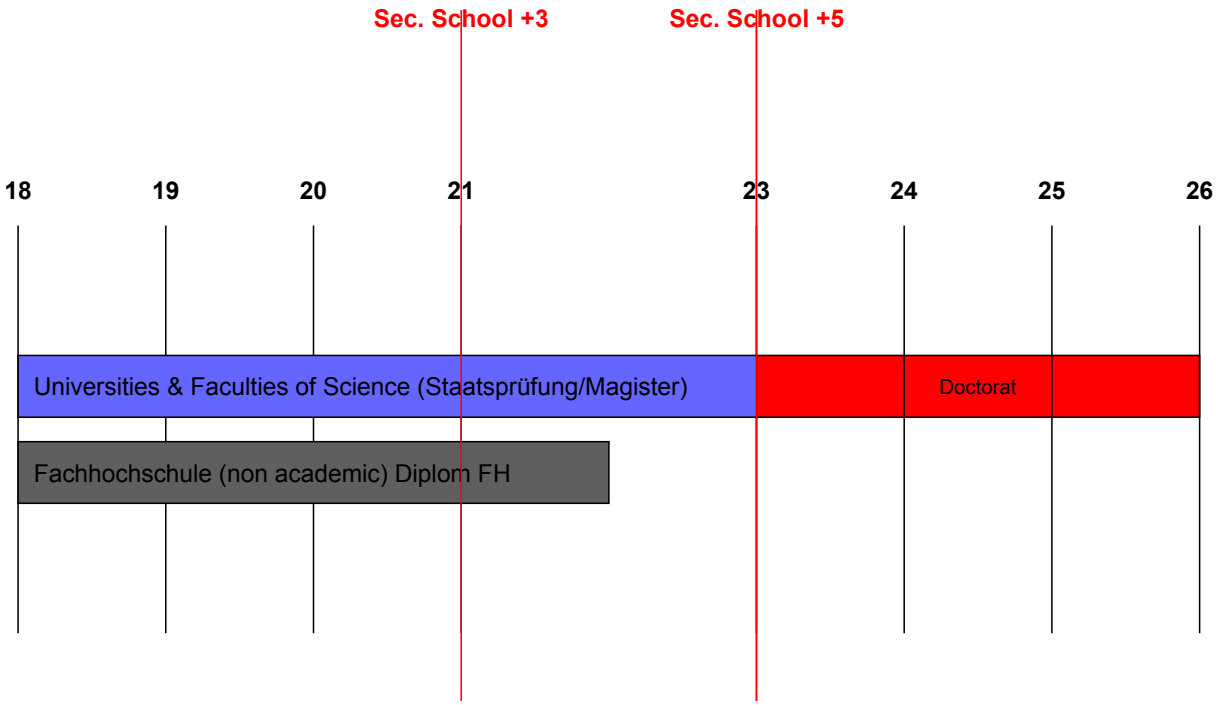


Figure 5.1: German Higher Education System in EIE Disciplines

In Germany the curriculum is slightly different at each University. In some Universities the electrical engineering and the computer science departments are combined and in other Universities they are separated.

5.1.1 Electrical and Information Engineering in Germany, boundaries of the field of study

List of general EIE subjects:

- Computer Sciences
- Medical Computer Sciences
- New Communication Technologies
- Business Informatics
- Electrical Engineering
- Microelectronics
- Microsystems Engineering
- Communications and Information Technology
- Optoelectronics

5.1.2 Content, degrees and accreditations

The curriculum of the degrees is defined by a committee in each department in each University and certified by the ministry of education in the federal states (*Länder*).

5.1.3 Implementation of the Bologna-BMD system in Germany

In Germany, we found traditionally:

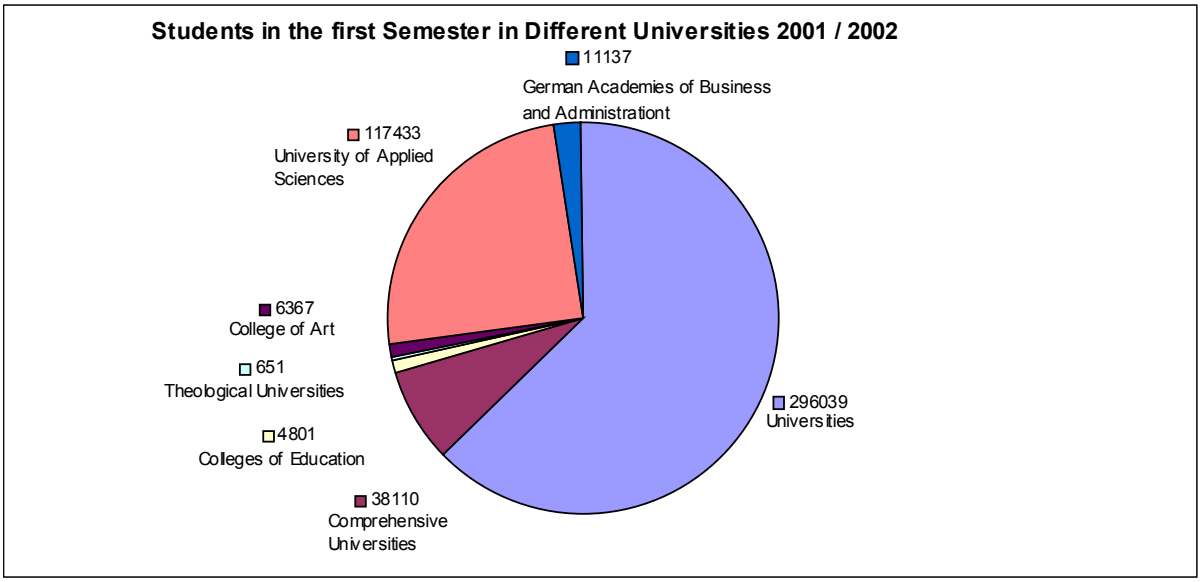
- *Diplom-Ingenieur*, the title that is awarded by German universities and technical universities for the successful completion of a scientific course program of nominally five years;
- *Diplom-Ingenieur (FH)*, the title that is awarded by German *Fachhochschulen* (universities of applied sciences) for the successful completion of a practice oriented course program of nominally four years.

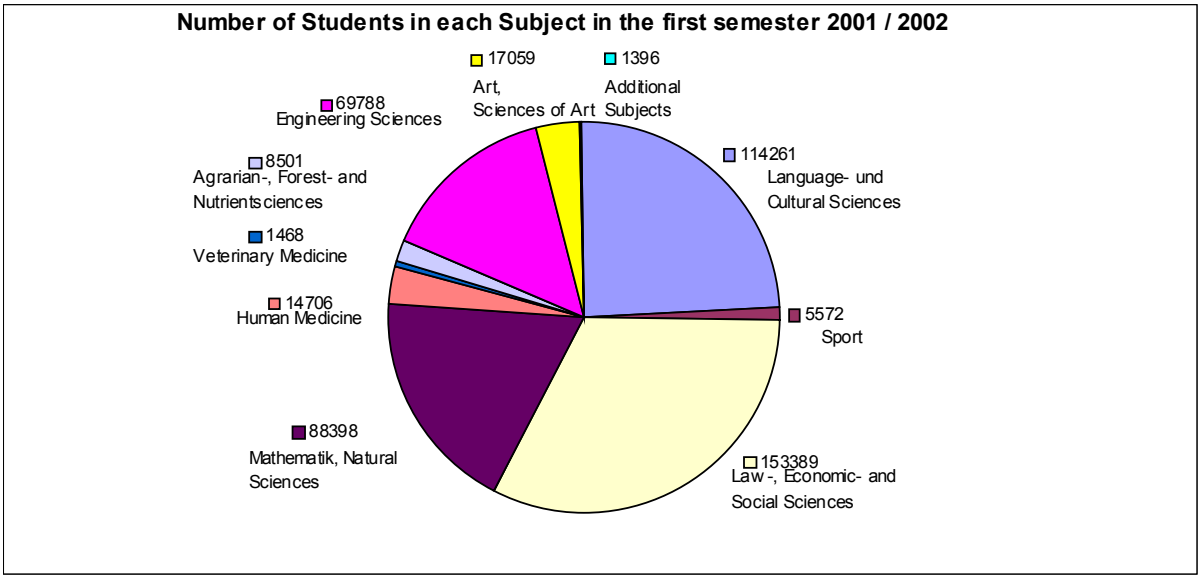
Bologna-BMD system is being introduced in the Germany federal schemes since 1998 in parallel with the traditional degree "diplom-ingenieur".

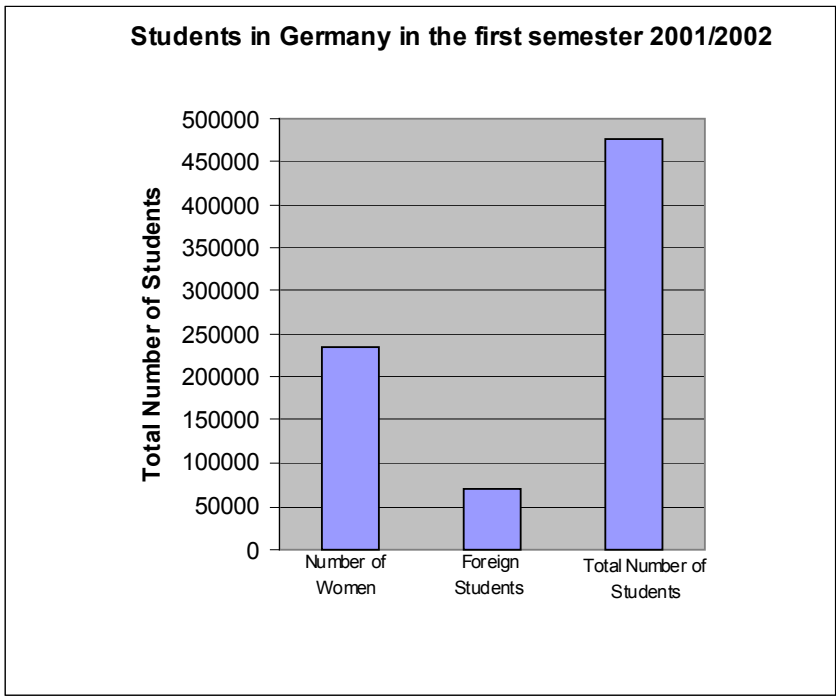
In some federal states, the encouragement to switch to the Bologna-BMD is stronger than in others. Some Universities propose "bachelor" and "master" curricula, in addition to traditional curricula. Some "masters" are proposed in English language, mainly for foreign students.

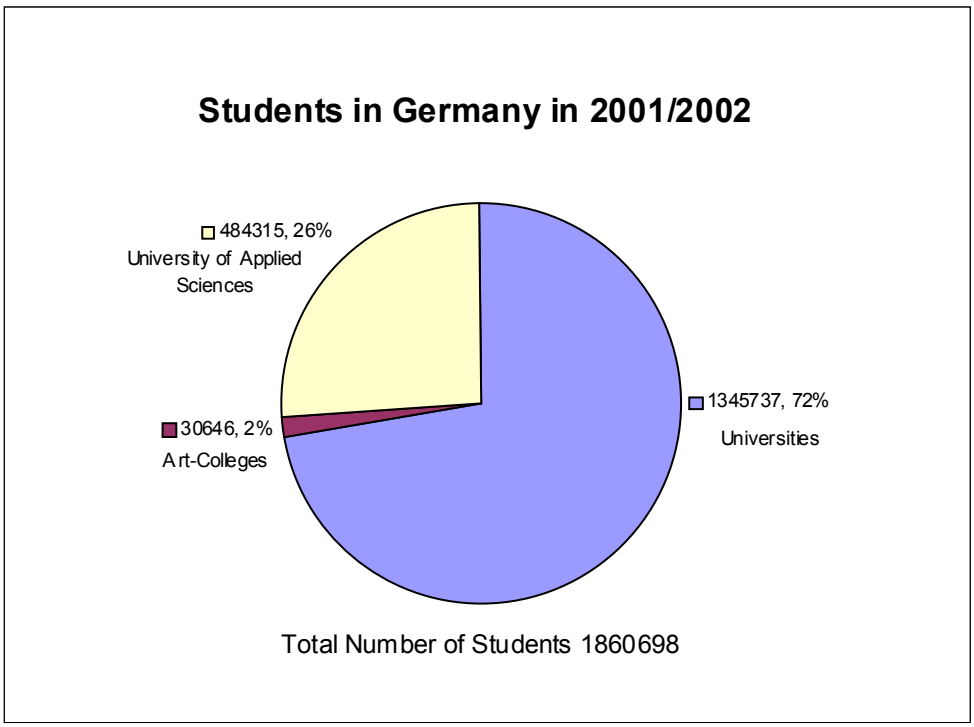
The Bachelor level is very similar to the *Fachhochschule* level (only a bit shorter). The Master level is closely aligned to the current University *Diplom-Ingenieur* programme.

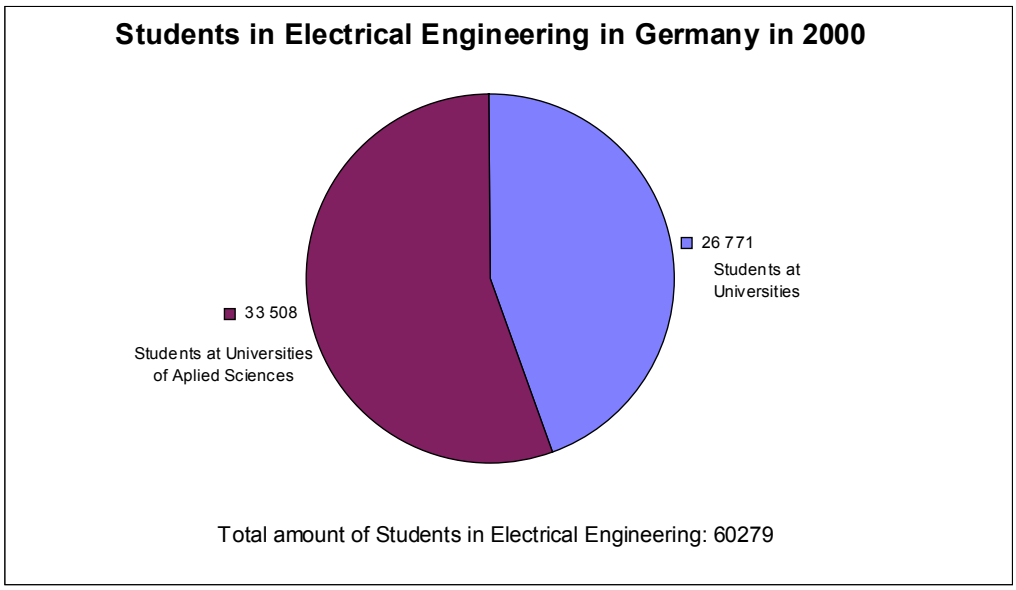
5.2. Figures on the weight of EIE in Germany

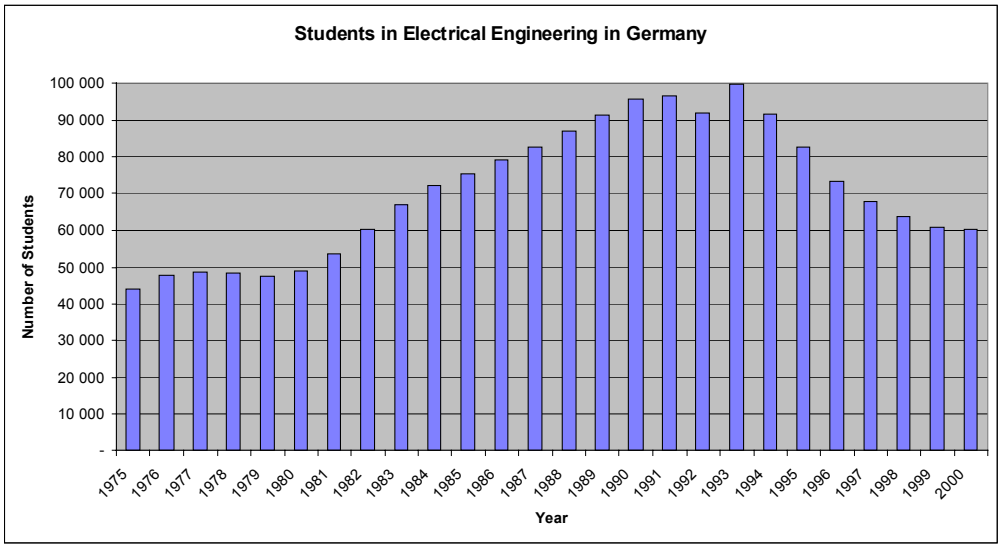





Students in Germany in the first semester 2001/2002
Total Number of Students
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Number of Women
Foreign Students
Total Number of Students


Students in Germany in 2001/2002
484315, 26%
University of Applied Sciences
30646, 2%
Art-Colleges
1345737, 72%
Universities
Total Number of Students 1860698


Students in Electrical Engineering in Germany in 2000
26 771
Students at Universities
33 508
Students at Universities of Aplied Sciences
Total amount of Students in Electrical Engineering: 60279


Students in Electrical Engineering in Germany
Number of Students
100 000
90 000
80 000
70 000
60 000
50 000
40 000
30 000
20 000
10 000
-
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
Year

5.3. Degrees in EIE in Germany

Relevant awards are made in 355 different Universities in Germany:

- Technician in various engineering disciplines (2 years)
- Diplomas in various engineering disciplines and informatics (7 to 9 Semesters)
- Bachelor (6 Semesters), Master (+ 4 Semesters) (introduced only recently)

5.3.1 Before bachelor (technician level)

This level is not considered as a University level, and not developed in the following.

5.3.2 Fachhochschul-level:

Automatic Control Engineering:

Control Systems	28%
Real-Time Data Processing	17%
Computer Engineering	17%
Process Measuring	15%
Drive Control	13%

Electrical Energy Engineering:

Electrical Machines and Drives	25%
Power Electronics	23%
Control Systems	17%
Drive Regulation	13%
Electrical Power Supply	12%

Communications Technology:

Networks, Signals, Systems	28%
Computer Engineering	23%
High-Frequency Engineering	17%
Analog Circuit	12%
Kryptografi Procedures and Applications	10%

Technical Data Processing:

Real-Time Data Processing	25%
Computer Engineering	22%
I/O Interfaces and Peripheral Devices	18%
Cryptographic Procedures and Applications	15%
Digital Image Processing	10%

5.3.3 University-level:

General Electrical Engineering:

Theoretical Electrical Engineering	25%
Semiconductor Electronics	18%
General Communications Engineering	13%
Data Processing	12%
Electrical Machines and Power Electronics	12%
Control Engineering	10%

Automatic Control Engineering:

Control Engineering	25%
Electrical Machines and Power Electronics	17%
Data-Acquisition and Data-Processing	15%
Real-Time Data Processing	13%
General Communications Engineering	10%
Theoretical Electrical Engineering	10%

Electrical Engineering:

Electrical Plants and Networks	25%
Electrical Machines and Power Electronics	17%
Data-Acquisition and Data-Processing	15%
High Voltage Engineering and Insulation Material	13%
Real-Time Data Processing	10%
Control Engineering	10%

Microelectronics:

Microelectronics	25%
Design of Integrated Systems	18%
Semiconductor Electronics	17%
Signal and System Theory	10%
General Communications Engineering	10%
Data Processing	10%

Communications Engineering:

General Communications Engineering	25%
Communication Transfer Technology	17%
Signal and System Theory	15%
Fields and Waves	13%
High and Very High Frequency Technology	10%
Data Processing	10%

Technical data processing:

Data Processing	25%
Algorithms and Data Structures	15%
I/O Interfaces and Peripheral Devices	15%
Real Time Programming	12%
Design of Integrated Systems	12%
Technical Computer Science	11%

The remaining 10% of the subjects, defined by each University, are general subjects, like Project management, English, Communications, Rhetoric and Public Relations.

5.4. References

- Quelle: "Studying in Germany" von DAAD. 6th Edition 1999,
- Federal Ministry of Education and Research.

6. EE: Eesti (Estonia)

Coordinating author: Raimund UBAR (EAEEIE, Tallinn Technical University, raiub@pld.ttu.ee)
Other contributors: Ennu RÜSTERN, Margus KRUUS (Tallinn Technical University)
Review: Jan LIGUŠ (EAEEIE, Technical University of Košice, Slovakia)

6.1. General information

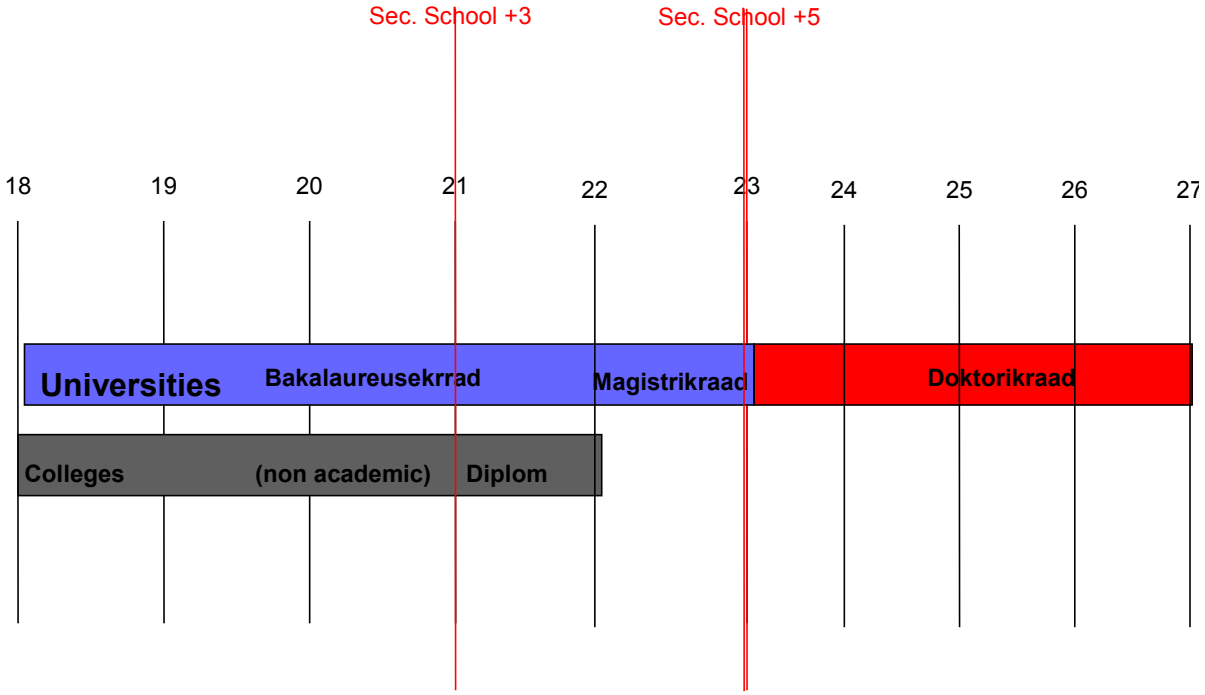


Figure 6.1: Estonian Higher Education System in EIE disciplines

There are 52 registered higher-education institutions including state and private universities and colleges in Estonia for 1.5 million inhabitants. One third of students pay for their studies by themselves.

- The Estonian higher education system is binary:
  - universities (ülikool),
  - applied higher education institutions (*rakenduskõrgkool*) - colleges.
- The system also incorporates some vocational higher education (*kutsekõrgharidus*) programmes at post-secondary vocational institutions (*kutseõppeasutus*).
- The higher education institutions can be state, public or private institutions.
- The right to award diploma or degree lies with the state college and the public university recognised by the state.
- Diplomas awarded by the private higher education institutions are recognised after the accreditation.

Organisation of a course of study

- Academic year is divided into two semesters: the autumn and spring semester.
- Academic year begins in September and ends in the first half of June. In general, it contains 40 weeks of lectures, seminars, practical training and two examination periods.
- The capacity of studies is measured in credits. One credit corresponds to forty hours (one study week) of studies performed by a student in whatever way. The nominal academic year consists of 40 credits (60 ECTS credits).

6.1.1 Electrical and Information Engineering in Estonia, boundaries of the field of study

In Estonia, the EIE specialities are specialities of very high priority. The largest educational institution in this area is Tallinn Technical University, where most EIE specialists are taught. The graduates of TTU have contributed to bringing the economy of Estonia to a high technology level and many of them occupy high places in Estonian banking and economics, in industrial, energy and ICT companies. The list of specialities in Tallinn Technical University is quite wide: in the field of Information Technology: Informatics, Computer and Systems Engineering, Telecommunication, Electronics, Business Information Technology and Computer Science; in the field of Electrical Engineering: Electrical Drives and Power Electronics and Electrical Power Engineering. Altogether, TTU accepts about 650-700 students in EIE specialities every year, about 400 of them receive government scholarships. Some EIE specialities are also taught in Tartu University and in Tallinn Pedagogical University. The applied programmes are offered in several colleges, most of which are connected to a university. Estonian Information Technology College (EITC, founded in 2000) is the largest educational institution of that kind in the IT field. EITC prepares the specialists of “IT Systems Development" and "IT Systems Administration" specialities. The most part of study plans of EITC is developed by professors of TTU, and the study process is conducted in close co-operation with IT faculty of TTU.

6.1.2 Content, degrees and accreditations

General requirements for studying and teaching are set by the Standard of Higher Education (SHE, adopted by the Government 13.08.2002). The SHE is a set of regulations instituted by the Government of the Republic. It specifies the purpose of a given programme of instruction leading to a certification of trade, vocational, or professional competence; the list of trades and occupations to which its regulations apply; and the general requirements that curricula must meet, also the list of study fields and specialities.

The content of the curricula of all specialities is approved by a curricula committee of the faculty, consisting of professors and industry experts and by the Council of University (TTU, TU, etc.). The curricula pass regular obligatory accreditation, during which independent international experts evaluate the curricula. Based on the reports of the expert committees, the Higher Education Quality Assessment Council decides on accreditation of the curriculum. The accreditation is valid for 7 years, in case of conditional accreditation the accreditation procedure has to be repeated in 2 years. Curricula which are not approved are terminated.
The educational contents of the degrees given in Estonia are presented in the following.

Non-academic higher education qualifications

- Vocational higher education diploma (*kutsekõrghariduse diplom*)
  - One-stage higher education offered by secondary education based on vocational education institutions (kutseõppeasutus) or colleges.
  - The length of study is from three to four years, the total capacity of studies 120 – 160 credits.
  - Vocational higher education programme includes practical training, accounting for at least 35% of the total capacity.
  - The graduates who have completed their studies are awarded a diploma with an indication of their speciality.
- Diploma (*Diplom*)
  - One-stage non-academic applied higher education. The length of study is from three to four years, 120 – 160 credits.
  - *Diplom*-study is a specialised higher education study, consisting of the studying and acquisition of practical knowledge and skills.
  - Acquisition of practical skills, including training, must have a total capacity of no less than 10 credits.
  - The graduates who have completed their studies will be awarded a diplom (with no academic degree).

- *Diplom*-study can be performed at universities (up to 2002) and colleges.
- The study programme of *diplom*-study at university and that of *bakalaureus*-study may have common courses.

Academic higher education qualifications

- *Bakalaureusekraad* (Bachelor)
  - First stage of academic study, the main purpose of which is to increase students' level of general education and develop theoretical knowledge and professional skills for the selected area of employment and further study.
  - *Bakalaureus*-level study is conducted in universities, and the length of study is 3 – 4 years (up to 1999 – 4 years, since 2002 – 3 years).
  - *Bakalaureus*-study is a theory-based wide-range study.
  - Research, professional or creative work, including final thesis, shall have a capacity of not less than 20 credits.
  - The graduates who have completed their studies will receive a diploma, certifying the obtained *bakalaureusekraad*.
- *Magistrikraad* (Master)
  - Second stage of academic study, the main purpose of which is to deepen theoretical and specialist knowledge and develop proficiency in research, professional or other creative work for individual use of knowledge and skills.
  - Admission requirement is the *bakalaureusekraad* or an equivalent level of academic education.
  - The length of study is 1 – 2 years (up to 1999 and since 2002 – 2 years).
  - The study will be completed with the defence of a thesis.
  - The degrees are divided into research and professional degrees. The graduates who have completed their studies will receive a diploma, certifying the obtained *magistrikraad*.
- *Doktorikraad* (PhD)
  - Third stage of academic study, consisting of comprehensive research, professional or other creative work and related studies.
  - Admission requirement for *doktor*-study is the *magistrikraad* or an equivalent level of academic education.
  - The nominal length of study is four years.
  - The degrees are divided into research and professional degrees.
  - The graduates who have completed their studies will receive a diploma, certifying the acquired *doktorikraad*.
- *University diploma*
  - University diploma with the qualification of engineer, is part of the old system of university qualifications, which is issued to the graduates, who started their study before 1 January 1995.
  - One-stage academic higher education.
  - The length of study is four or five years, the total capacity of studies is 135 or 180 credits.
  - The graduates who have completed their studies will receive a diploma, certifying the obtained title of engineer.

6.1.3 Implementation of the Bologna-BMD system in Estonia

Up to year 2001 the 4-6-10 study system was used in Estonian high education. The Government of Estonia has fixed the goal to be achieved for higher educational institutions, taking into account the tasks related to the accession of Estonia to the European Union. All substantial features of the Bologna mainframes were built into the SHE.

In accordance with SHE the revision of curricula was conducted and in year 2002 new 3-5-9 curricula were introduced. Doctoral programmes were also substantially renewed and brought up to date, but they still remain mostly 4-year programmes. The number of different programmes was brought down to a minimum. For example, in TTU there are only two doctoral programmes in the area of EIE: "Information and Communication Technology" and "Power Engineering and Geotechnology". Since 2002 the applied higher education and diploma studies have taken place only in colleges.

6.2. Figures on the weight of EIE in Estonia

Figure 6.2: EIE students in Estonia in the first semester 2001/02

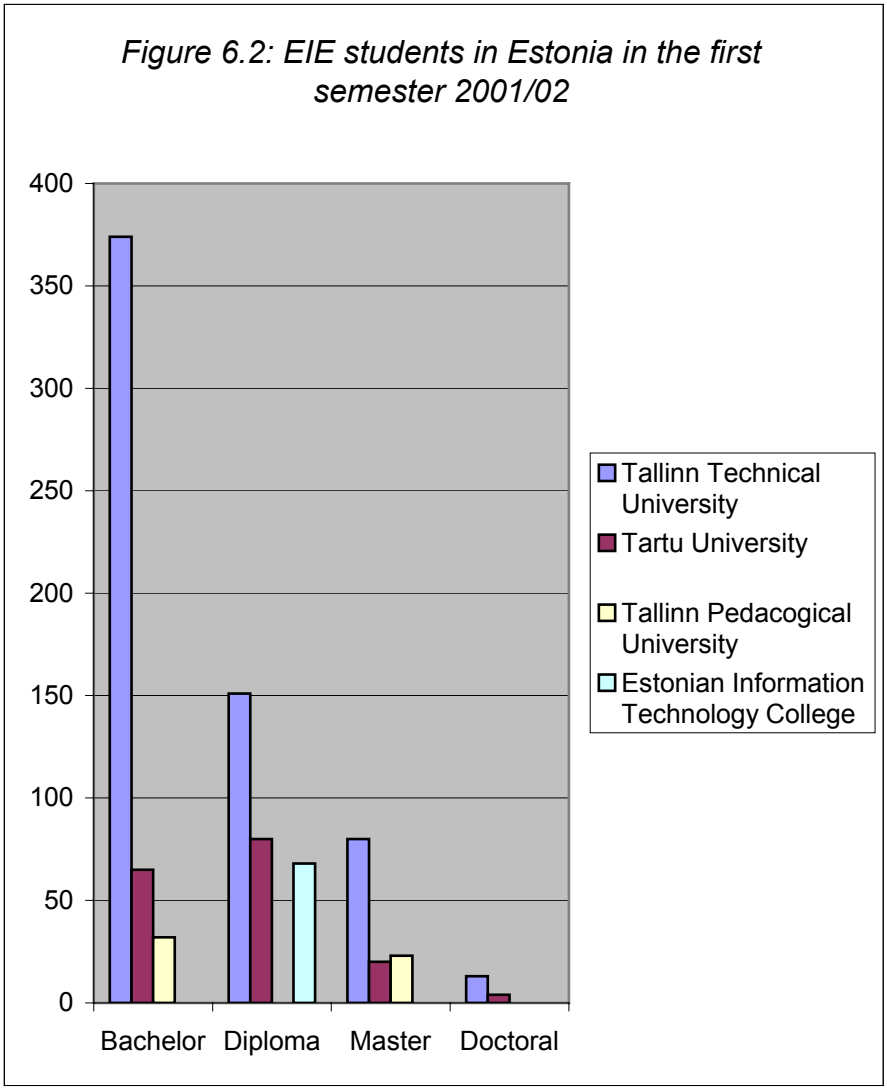


Figure 6.3: Students in Tallinn Technical University in 2001/2002

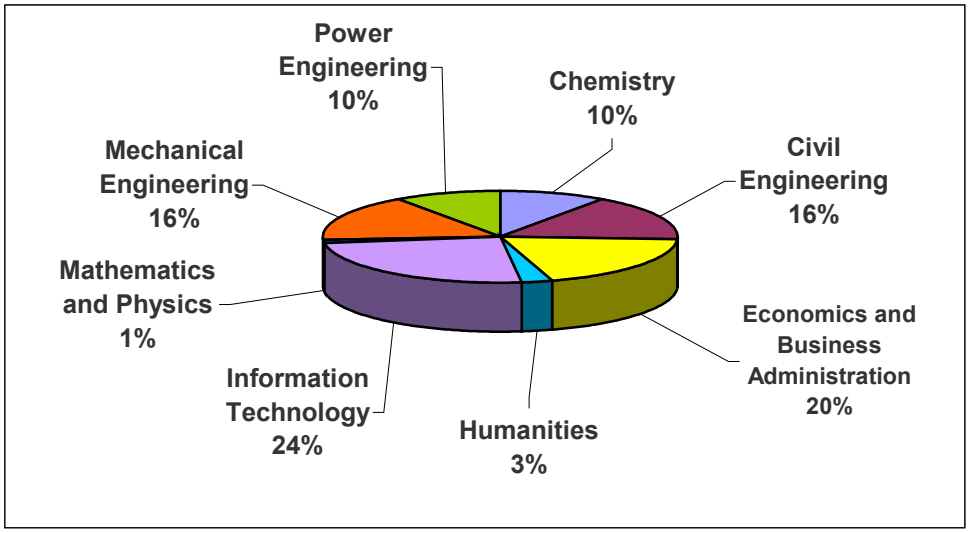


Figure 6.4: Students in the first semester in the IT faculty of Tallinn Technical University 2002

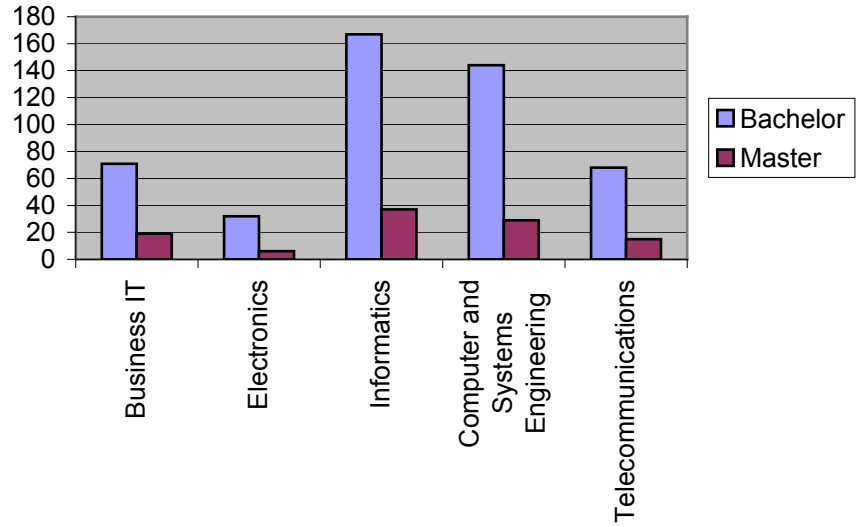
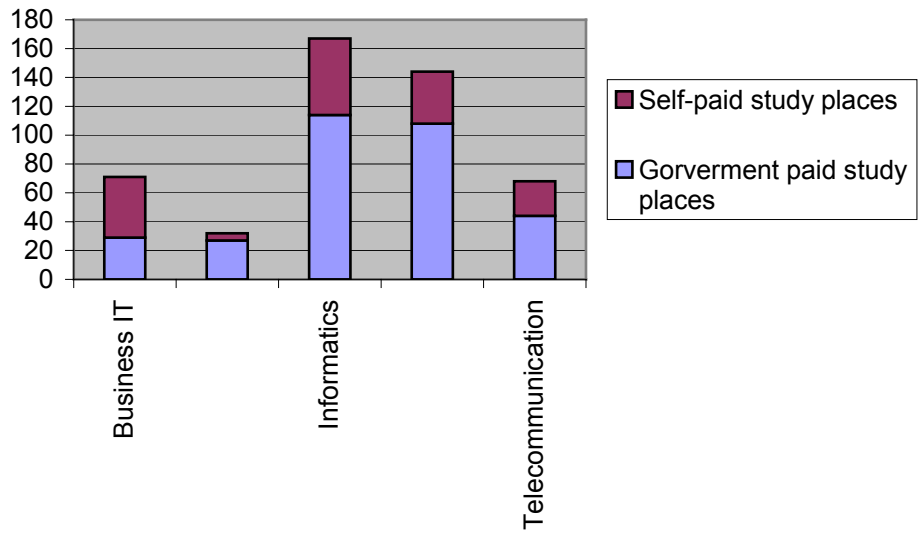


Figure 6.5: Bachelor students in the first semester (IT faculty of Tallinn Technical University, 2002)



6.3. Degrees in EIE in Estonia

Non-academic higher education qualifications

- Vocational higher education diploma
- Diploma

Academic higher education qualifications

- Bakalaureusekraad (Bachelor)
- Magistrikraad (Master)
- Doktorikraad (PhD)
- University diploma

6.3.1 Before bachelor (Vocational higher education)

IT Systems Administration

Specialities: Computers & Networks –10%, Programming – 15%, IT Systems: Analysis, Design& Programming – 17.5 %, IT Systems Administration - 10 %, Diploma Thesis – 8%

Fundamentals: Mathematics & Physics - 9%, Humanities & Economics – 11% , English – 4.5%, Industrial Training – 15%

IT Systems Development

Specialities: Computers & Networks –13%, Programming – 15%, IT Systems: Analysis & Design – 10.5 %, IT Systems Development - 10 %, Diploma Thesis – 8%

Fundamentals: Mathematics & Physics – 13%, Humanities & Economics – 11% , English – 4.5%, Industrial Training – 15%

Information Technology

Specialities: Computers –12%, Programming -12%, Special Software – 20%, Hardware - 8%, Diploma Thesis – 5%

Fundamentals: Mathematics & Physics - 8%, Humanities & Economics – 15% , English – 5%, Industrial Training – 15%

Telecommunication Equipment

Specialities: Computers & Networks - 8%, Electronics & Telecommunication Basics –14%, Programming -5%, Telecommunication Hardware & Software – 21%, Diploma Thesis – 5%

Fundamentals: Mathematics & Physics - 10%, Humanities & Economics – 13% , English – 5%, Industrial Training – 15%

6.3.2 Bachelor level

Bachelor in Electronics :

Specialities: Electronics – 21% , Informatics – 12,5% , Telecommunications – 10% , Networks – 7,5%, Control – 9%

Fundamentals: English – 2%, Expression-communication – 2%, Humanities – 8%, Industrial training – 2,5%

Bachelor in Telecommunications :

Specialities: Electronics – 5% , Informatics – 16% , Telecommunications – 27% , Networks – 10%, Control – 6%

Fundamentals: English – 2%, Expression-communication – 2%, Humanities – 8%, Industrial training – 2,5%

Bachelor in Computer and System Engineering

Specialities: Electronics – 5% , Informatics – 33% , Telecommunications – 3% , Networks – 8%, Control – 12%

Fundamentals: English – 2%, Expression-communication – 2%, Humanities – 8%, Industrial training – 2,5%

Bachelor in Informatics

Specialities: Introduction to Informatics - 10 %, Signals, Circuits& Systems – 8 %, Computers & Networks - 9 %, Programming – 20.5 %, Information Systems or Network Applications – 12 %, Bachelor Thesis - 4 %.

Fundamentals: Mathematics & Physics - 22.5 %, Humanities & Economics – 9.5 %, English - 2 %, Industrial Training – 2.5 %.

Bachelor in Business Information Technology

Specialities: Introduction to Informaion Technology - 7 %, Computer& Network – 6 %, Information Systems – Analysis, Design, Programming and Development – 37.5 %, Network Applications – 6 %, Organization Management – 7.5 %, Bachelor Thesis - 4 %.

Fundamentals: Mathematics & Physics - 16 %, Humanities& Economics – 11.5 %, English - 2 %, Industrial Training – 2.5 %.

Bachelor in Electrical Drives and Power Electronics

Specialities: Informatics – 4%, Measurements – 4%, Microprocessors& Electronics – 10 %, Robots – 6%, Control – 9 %, Electrical Engineering – 21.5 %, Electrical Drives – 18 %

Fundamentals: Mathematics & Physics – 17%, Humanities & Economics – 6%, English – 2%, Industrial Training – 2.5 %.

6.3.3 Intermediate level, between bachelor and master (University diploma)

Informatics

Specialities: Introduction to Informatics - 8 %, Computers & Networks – 4.5 %, Programming – 14 %, Information Systems – Analysis, Design, Programming and Development - 38 %, Information Systems and Network Management – 3 %, Diploma Thesis - 6 %.

Fundamentals: Mathematics - 9 %, Humanities & Economics – 11.5 %, Industrial Training – 6 %.

Computer Systems

Specialities: Computers & Networks –12 %, Programming –23.5 %, Microprocessor Systems – 6 %; Digital Systems- Diagnostics, Design and Test – 12 %; Hard- and Software Codesign – 5%; Systems-on-Chip Design – 5%; Diploma Thesis - 6 %.

Fundamentals: Mathematics & Physics - 13 %, Humanities & Economics – 11.5 %, Industrial Training – 6 %.

Telecommunication

Specialities: Signals, Circuits, Systems, Control - 6 %; Informatics- 5 %; Electronics – 7 %; Signal Processing, Signal Processors – 12 %; Microwave Engineering - 7 %; Telecommunication Networks and Systems – 26.5 %, Diploma Thesis - 6 %.

Fundamentals: Mathematics & Physics - 13 %, Humanities & Economics – 11.5 %, Industrial Training – 6 %.

Network Software

Specialities: Introduction to Computer Science - 18 %, Computers & Networks – 6 %, Programming – 14 %, Information Systems – 13 %, Network Applications - 12 %, Diploma Thesis - 6 %.

Fundamentals: Mathematics & Physics - 14 %, Humanities & Economics – 11 %, Industrial Training – 6 %.

Admittance to these specialities finished in 2001.

6.3.4 Master level

Master in Electronics

Specialities: Electronics – 14 %; Data Acquisition and Measurements, Sensor Signal Processing – 9 %; Circuit Design, ASIC design, Chip Design, Test and Diagnostics – 15.5 %; Electronic Systems - 15 %; Biomedical Electronics - 9 %; Master Thesis - 25 %.

Fundamentals: Humanities & Economics – 6%; English – 2.5 %, Industrial Training – 4 %

Master in Telecommunications

Specialities: Communication Theory – 7.5; Signal Processing & Signal Processors – 16.5 %; Telecommunication Networks and Systems – 14 %; Telecommication Systems Analysis, Modelling and Design – 18.5 ; Telecommunication Standards – 6%; Master Thesis – 25%.

Fundamentals: Humanities & Economics – 6 %, English – 2.5 %, Industrial Training – 4 %.

Master in Computer and Systems Engineering

Specialities: Digital Systems – Modelling, Diagnostics, Test, Design and Programming – until 30 %; Signals, Systems and ASIC Design – until 16 %; Modelling and Control – until 17.5 %; Control Instrumentation – until 24% ; Embedded Systems –until 10%; Software Engineering – until 30%; Project Management – until 10%; Master Thesis – 25%.

Fundamentals: Humanities & Economics – 6 %, English – 2.5 %, Industrial Training – 4 %.

Master in informatics

Specialities: Advanced Programming - 11 %, Data Security – 9 % , Information Systems – Analysis, Design, Programming and Development -21%; Network Applications – 12.5 %, Network Administration - 9 %, Master Thesis - 25 %

Fundamentals: Humanities & Economics – 6 %, English – 2.5 %, Industrial Training – 4 %.

Master in Informatics (for those whose Bachelor degree was not Informatics)

Specialities: Programming – 12 %, Data Security – 5 % , Information Systems –Analysis, Design, Programming and Development –33.5 %; Network Applications – 12 %, Project Management - 6 %, Master Thesis - 25 %.

Fundamentals: English – 2.5 %, Industrial Training – 4 %.

Master in Business Information Technology

Specialities: Data Security – 9, Information Systems – Analysis, Design, Programming and Development – 23 %, Network Applications – 6 %, Intelligent and Agent Systems – 11.5% , IT Projects Management - 19 %, Master Thesis - 25 %.

Fundamentals: English – 2.5 %, Industrial Training – 4 %.

Master in Electrical Drives and Power Electronics

Specialities: Electrical Engineering – 6 %, Programming – 6 %, Automation – 9%, CAD – 9 %, Electricac Drives – 11%, Robots –6%, Power Electronics –6%, Master Thesis – 25%.

Fundamentals: Mathematics – 4.5 %, Humanities & Economics – 15%, English – 2.5%.

6.3.5 Doctoral level

Doctor in Information and Communication Technology

List of specialities: Informatics, Information Technology, Computer and Systems Engineering, Electronics, Telecommunication.

Specialities - 19%, **Fundamentals** - 6%, **Doctoral Thesis** - 75%

Doctor in Power Engineering and Geotechnology

Specialities - 21%, **Fundamentals** - 4%, **Doctoral Thesis** - 75%

6.4. References

The information given in this monograph is based on the following documents and web links:

http://www.hm.ee/ (Estonian Ministry of Education)
http://www.ekak.archimedes.ee/ (Higher Education Quality Assessment Council)
http://www.ttu.ee/index_eng.html (Tallinn Technical University)
http://www.ut.ee/english/ (Tartu University)
http://www.itcollege.ee/inenglish/index.php (Estonian Information Technology College)
http://www.tpu.ee/english.html (Tallinn Pedagogical University)

7. ES: España (Spain)

Coordinating author: Angel GARCÍA (EAEEIE, Universidad de Málaga, angelg@ic.uma.es)
Other contributor: José V. BENLLOCH (EAEEIE, Universidad Politécnica de Valencia, jbenlloc@disca.upv.es)
Review: Antti LUUKKO (EAEEIE, Lappeenrannan teknillinen yliopisto, Suomi/Finland)

7.1. General information

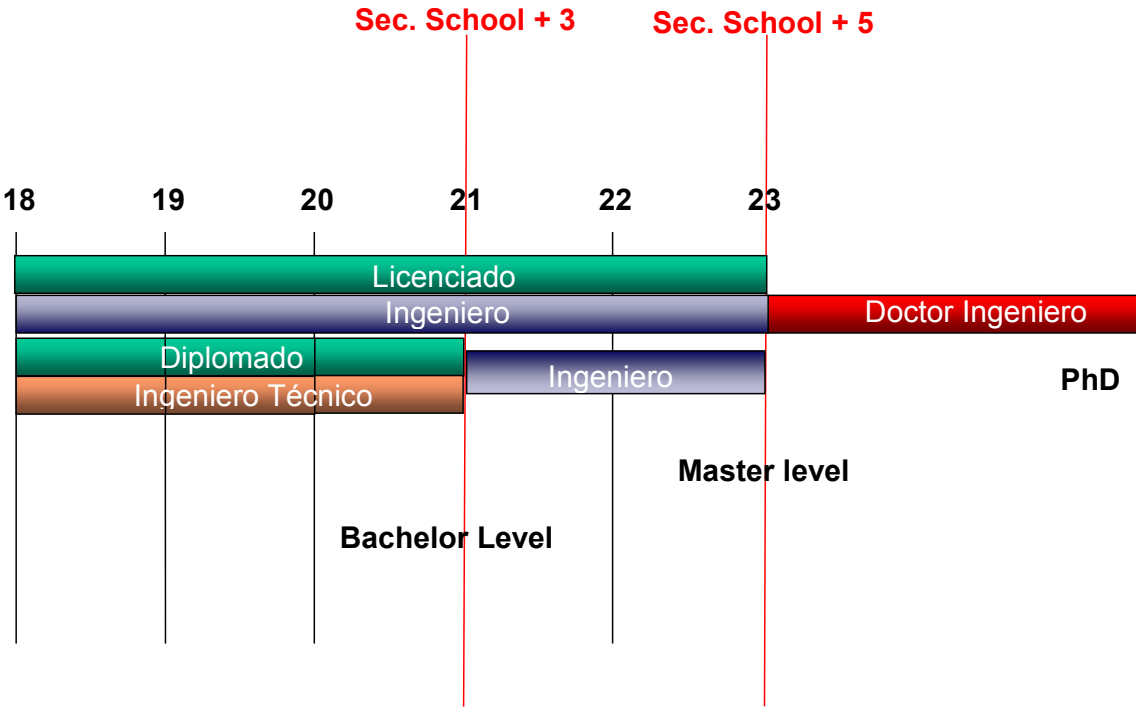


Figure 7.1: Spanish Higher Education System in EIE disciplines

The access to University is dependent on the passing of an examination called "*Selectividad*", which takes place right after the completion of the "*Bachiller*" (at the age of 18). A general view of the Spanish higher educational system is depicted in figure 7.1.
A new educational law (LOU) has been introduced recently, and may carry profound changes in the organization of higher education. As an example, according to the new legislation, this "*Selectividad*", which is a general test for all Universities in the country, will be replaced by specific admission exams at each faculty. The law above (LOU) already has encountered considerable opposition by the academic community.

7.1.1 Electrical and Information Engineering in Spain, boundaries of the field of study

Basically, EIE consists of three major areas:
1. *Telecommunication engineering*: devoted to information and communications technologies;
2. *Informatics*, which can correspond to computer engineering in Anglo-Saxon countries;
3. *Electro-mechanics* and *Automation*: the part of electromagnetism concerned with the generation and distribution of power as well as systems control.
The obtainable diplomas are issued in accordance with the division above, although the so-called "boundaries" are occasionally fuzzy (see 7.3).

7.1.2 Content, degrees and accreditations

The content of the degrees must be compliant with:

a. *Directrices generales comunes*, or general common guidelines, which define the general structure of the studies.

b. *Directrices generales propias*: or specific guidelines for a given diploma (more at http://www.mec.es/consejou/titulos/boestitu.html)

The guidelines above establish the minimum requirements necessary in order to obtain a particular diploma. These directions are set by an experts commission; this commission consists of members of the academic community appointed by the *Consejo de Coordinación Universitaria* (University Council).
The *Consejo de Coordinación Universitaria* is a board under the *Ministerio de Educación, Cultura y Deporte* for the improvement of teaching and research, the co-ordination of universities and the planning of higher education. It consists of a president (the minister of the government responsible for university education), the *Consejeros de Educación* (education ministers) of the *Comunidades Autónomas* (the 17 autonomous regions of Spain), the rectors of all the public universities of the country and fifteen people of acknowledged qualification, ten of which are elected by the national parliament and five by the government.
In addition to the above, the syllabi may optionally comply with the:

c. *Directrices universitarias*, which are guidelines specifically set by each university.

Each university periodically releases the syllabi of its studies; since these are often updated, a web search in the site of each institution is probably the best way to obtain them.

7.1.3 Implementation of the Bologna-BMD system in Spain

At present two systems coexist:

1. A **"5-7"** system: 5 years, divided in two cycles of 3 and 2 years respectively, for getting a master (Ingeniero);
afterwards a third cycle of two years and a thesis for the doctorate (Doctor Ingeniero).
2. A **"3-5-7"** system: 3 years for becoming a bachelor (Ingeniero Técnico), then joining the second and third cycles above for getting the master (Ingeniero) and the doctorate (Doctor Ingeniero).

There is a great controversy over the implementation of the Bologna-BMD model, because although, in principle, it is possible, only a low percentage (some 15 %) of those who receive masters are former bachelors that enrol in the second cycle. The main point is that going the 5-7 way means getting a first cycle of hard theory stuff, which is barely comparable with a much more applied first cycle of the 3-5-7 way.

7.2. Figures on the weight of EIE in Spain.

A few general statistics about education in Spain are presented in order to provide some context to the information on EIE :

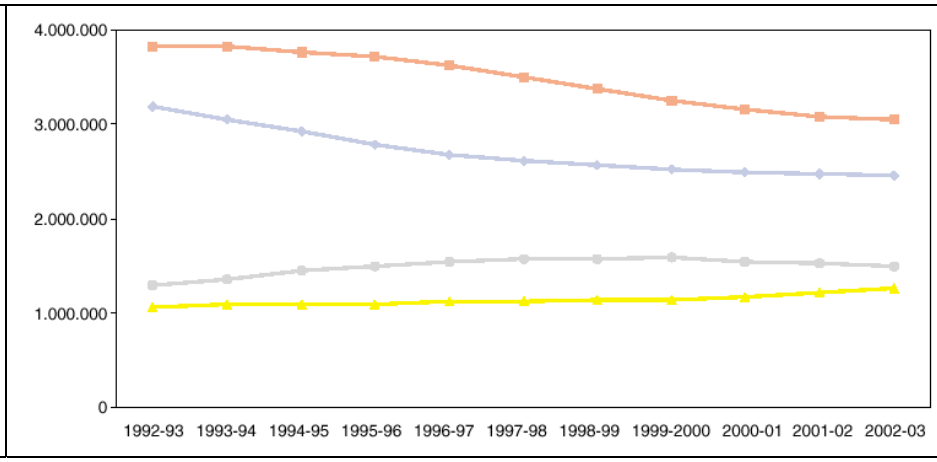
1st curve: **Secondary school** 2nd curve: **Primary school** 3rd curve: **Universities** 4th curve: **Kindergarten**	

Figure 7.2: Evolution of the number of students in Spain:

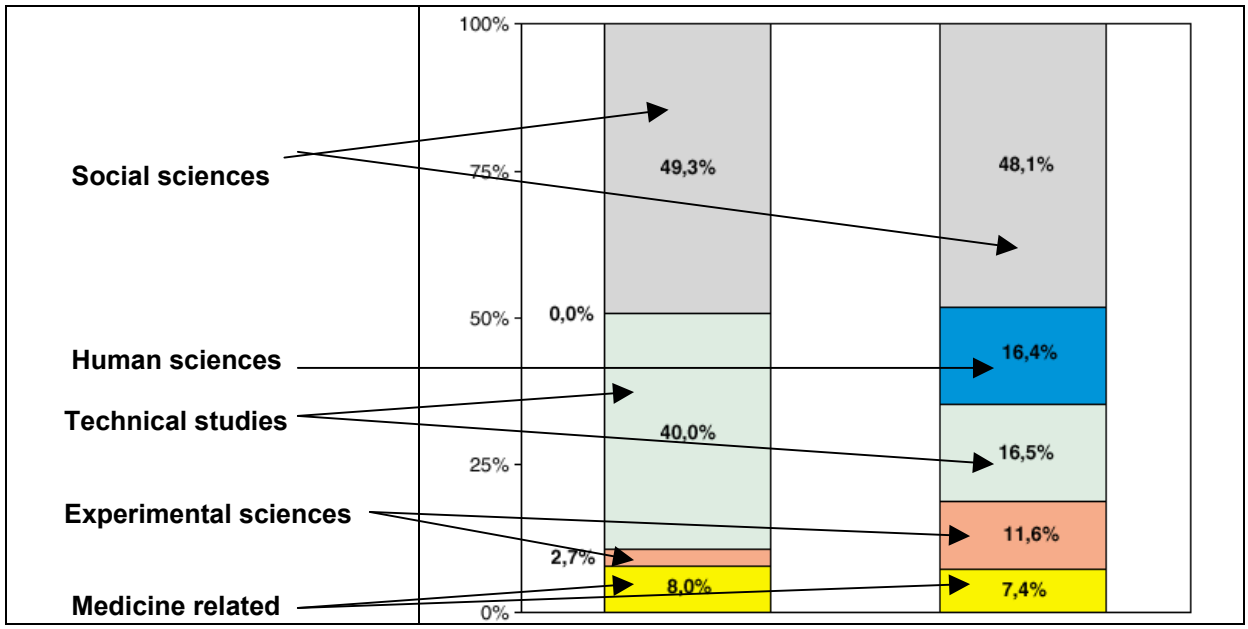


Figure 7.3: Distribution of students enroled in Bachelor (left column) or Master studies (right) according to their character:

The following table summarizes the most relevant figures concerning EIE education in the academic year 1999-2000; trend shows a stabilized course in the number of registrations in more recent years.

Academic year 1999-2000	No. of registered students			New registrations			No. of graduated students		
	Total	% Male	% Female	Total	% Male	% Female	Total	% Male	% Female
INGENIERÍAS TÉCNICAS (Bachelor level)									
Ingeniería Técnica Industrial (Industrial Engineering)	65.723	81,4	18,6	13.794	81,7	18,3	8.338	81,3	18,7
Ingeniería Técnica Informática (Computer Engineering)	59.612	80,7	19,3	13.112	81,9	18,1	3.746	75,8	24,2
Ingeniería Técnica de Telecomunicación (Telecommunications Engineering)	15.742	80,9	19,1	3.957	80,5	19,5	1.446	79,5	20,5
INGENIERÍAS (Master level)									
Ingeniería Industrial (Industrial Engineering)	39.755	78,9	21,1	6.169	77,6	22,4	4.452	79,6	20,4
Ingeniería Informática (Computer Engineering)	24.816	82,1	17,9	4.862	84,6	15,4	2.668	74,7	25,3
Ingeniería de Telecomunicación (Telecommunications Engineering)	16.433	75,6	24,4	3.137	74,4	25,6	1.614	73,2	26,8

(Source: *'Cifras de la educación en España, Las (Estadísticas e indicadores)'. Edición 2002 , Dirección General de Prog. Económica, Personal y Servicios. Ed. 2002 NIPO: 176-02-037-2 ISBN: 84-369-3565-9 Información y legislación educativa.*
A CD-ROM edition, which is a synthesis of the most relevant aspects of education in Spain from a variety of information sources, estimations, statistics and graphics)

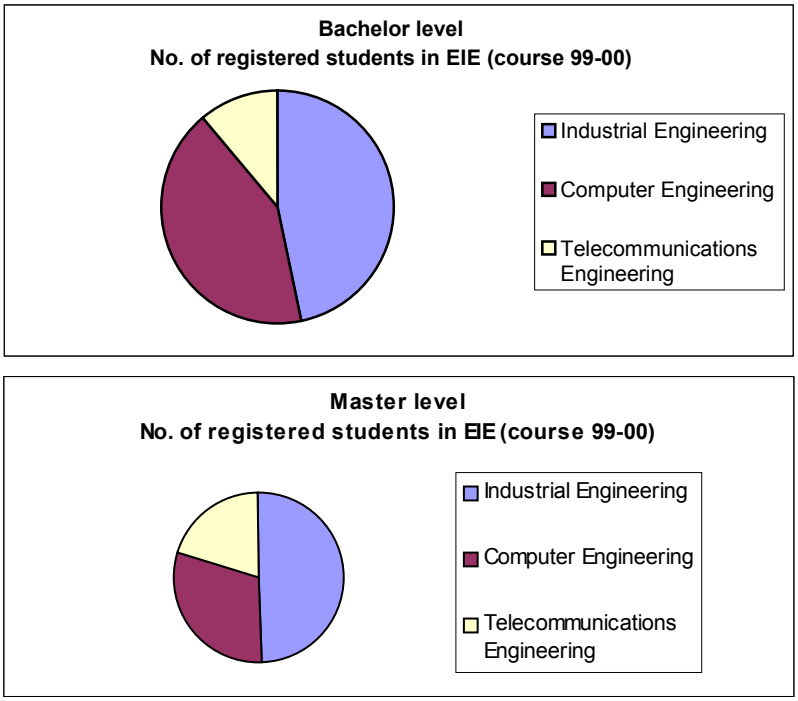


Figure 7.4: Distribution of students enroled in EIE Bachelor (left column) or Master studies (right) according to their character.

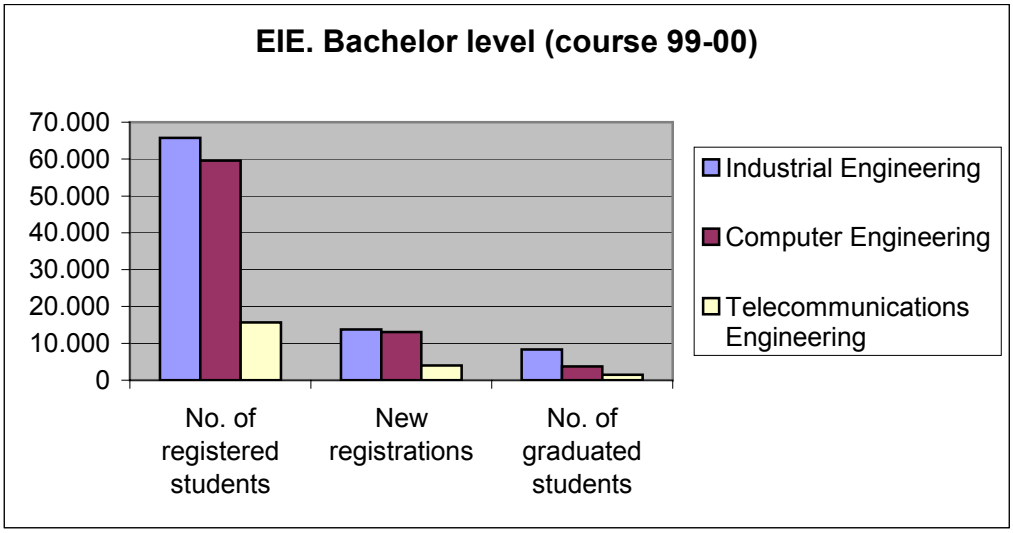


Figure 7.5: Detail of the figures concerning EIE Bachelor students

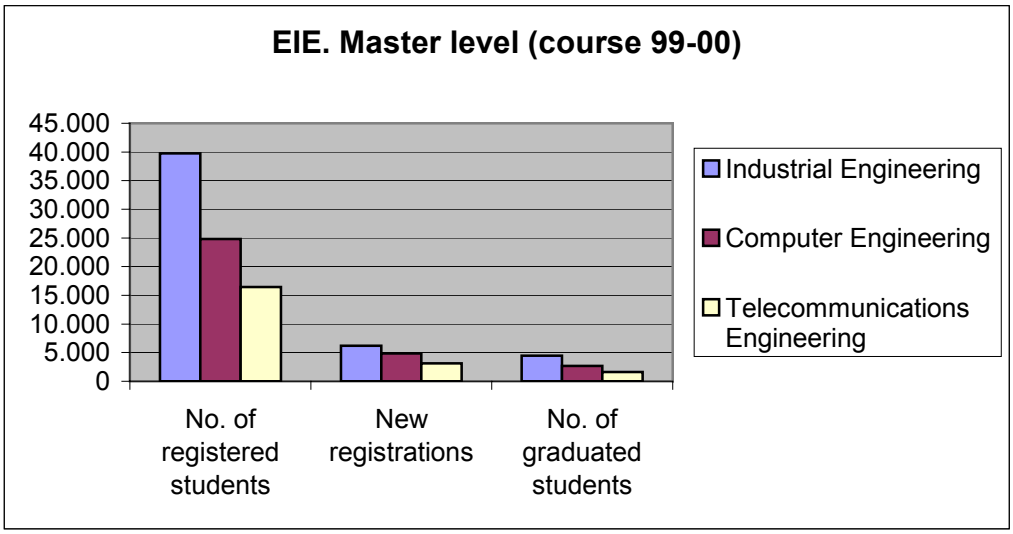


Figure 7.6: Detail of number of students pursuing an EIE Master

7.3. Degrees in EIE in Spain

The degrees related to EIE are listed below, more or less in correspondence with section 7.1.1, as well as the level achieved. The links below define their core contents (main subjects), as provided in a wide but *mandatory* sense by the Ministry. Along with them, *obligatory* as well as *optional* subjects, both ruled by each Centre, complete the degree syllabus. These latter subjects (obligatory and optional) must comply with each particular University's regulations, as already mentioned in epigraph 7.1.2.c, and, due to the large amount of institutions, they are not linked in this document.
The doctoral study (*Doctores Ingenieros* or PhD) is only possible after the master degree.

7.3.1 Before bachelor (*Formación Profesional* or technician level)

There are two levels for a technician degree. The lower, or *Formación Profesional Específica de Grado Medio*, runs parallel to the *Bachillerato* (high school), while the upper, or *Formación Profesional Específica de Grado Superior* can only be obtained afterwards. We will only refer here to the latter.

The duration of these studies is 2000 hours, and the specialities related to EIE are:

T1. Development of electronic products (*Desarrollo de Productos Electrónicos*)
T2. Electrotechnical installations (*Instalaciones Electrotécnicas*)
T3. Regulation and automatic control systems (*Sistemas de Regulación y Control Automáticos*)
T4. Telecommunications and informatic systems (*Sistemas de Telecomunicación e Informáticos*)
T5. Informatic applications development (*Desarrollo de Aplicaciones Informáticas*)
T6. Informatic systems management (*Administración de Sistemas Informáticos*)

More information can be obtained from the web of the Ministry.

7.3.2 Bachelor level (Ingeniero Técnico)

B1. Ingeniero Técnico de Telecomunicación. There are four different specialities:

- Telecommunications systems *(Sistemas de Telecomunicación)*
- Electronic systems *(Sistemas Electrónicos)*
- Sound and Image *(Sonido e Imagen)*
- Telematics *(Telemática)*

B2. Ingeniero Técnico en Informática de Gestión
B3. Ingeniero Técnico en Informática de Sistemas

B4. Ingeniero Técnico Industrial, with only two specialities related to EIE:

- *Electricidad*
- *Electrónica Industrial*

B5. Diplomado en Radioelectrónica Naval

7.3.3 Master level

7.3.3.1 *Ab initio* master

M1. Ingeniero de Telecomunicación
M2. Ingeniero en Informática
M3. Ingeniero Industrial (some specialities only)

7.3.3.2 Master level (Bachelor level + 2nd cycle)

These diplomas may only be awarded after a bachelor degree, enrolling for a second cycle of two years.

M4. Ingeniero en Automática y Electrónica Industrial
M5. Ingeniero en Electrónica
M6. Licenciado en Radioelectrónica Naval

7.4. References

The information given in this monograph is based on the following documents and web links:

- Draft of the University catalogue for the academic year 2002-03. Vicesecretariat of Studies. University Council
- La integración del sistema universitario español en el Espacio Europeo de Enseñanza Superior. Documento-Marco. Ministerio de Educación, Cultura y Deporte. Febrero, 2003.
- El grado en el Espacio Europeo de Educación Superior (EEES). Grupo de trabajo de la Conferencia de Rectores de las Universidades Españolas (CRUE) sobre Espacio Europeo de Educación Superior. 16 de marzo de 2003.
- Cifras de la educación en España, Las (Estadísticas e indicadores)'. Edición 2002 , Dirección General de Prog. Económica, Personal y Servicios. Ed. 2002 NIPO: 176-02-037-2 ISBN: 84-369-3565-9 Información y legislación educativa,
- Web of the Ministry for Education, Culture and Sport (MEC) at: http://www.mec.es
- Web of the University Council at: http://www.mec.es/consejou/index.html
- Statistics of the Ministry for Education, Culture and Sport (MEC) at: http://www.mec.es/estadistica/p_estadist.html
- Statistics from the University Council: http://www.mec.es/consejou/documen/pubestad.html
- Obtainable degrees, classified on a degree as well as awarding University basis at: http://www.mec.es/consejou/oferta/index.html
- Specific guidelines on a degree basis at: http://www.mec.es/consejou/titulos/boestitu.html

8. FI: Suomi/Finland

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Other contributions: Pentti LAPPALAINEN (EAEEIE, Oulun Yliopisto, pl1@ees2.oulu.fi)
Review: Cyril BURKLEY (EAEEIE, University of Limerick, Ireland)

8.1. General information

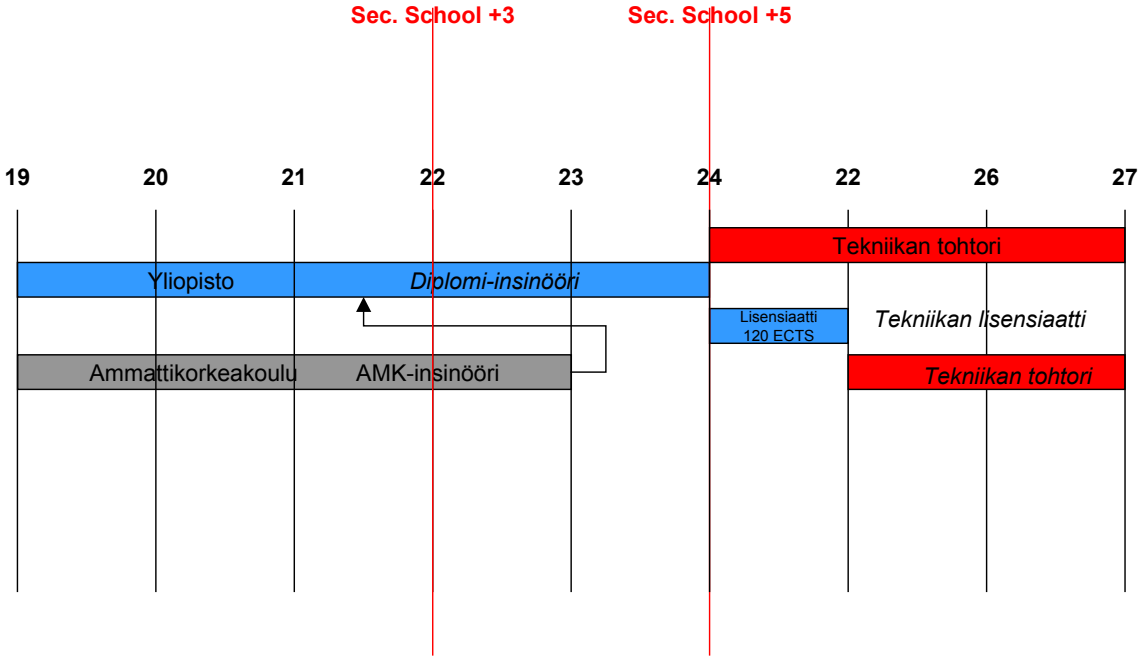

Figure 8.1: Finnish Higher Education System in EIE disciplines

Finland has nine years of compulsory schooling. Comprehensive schools are primarily run by local authorities, with the exception of a few private schools. The government contributes to the financing of all of the schools.

After compulsory schooling, young Finns can choose between general and vocational upper secondary education. Half of them opt for the upper secondary school (*lukio*). The upper secondary school ends in a national matriculation examination. The matriculation certificate provides eligibility for university education.

In upper secondary vocational education the study programmes (*ammattikoulu*) take from two to three years to complete. All three year study programmes provide eligibility for institutions of higher education. Students who have passed the matriculation examination or have a basic vocational qualification are eligible for admission. The system is currently being reformed: eventually, all higher vocational education will be provided at polytechnics (*ammattikorkeakoulu*, AMK, in Swedish *yrkeshögskola*, YH).

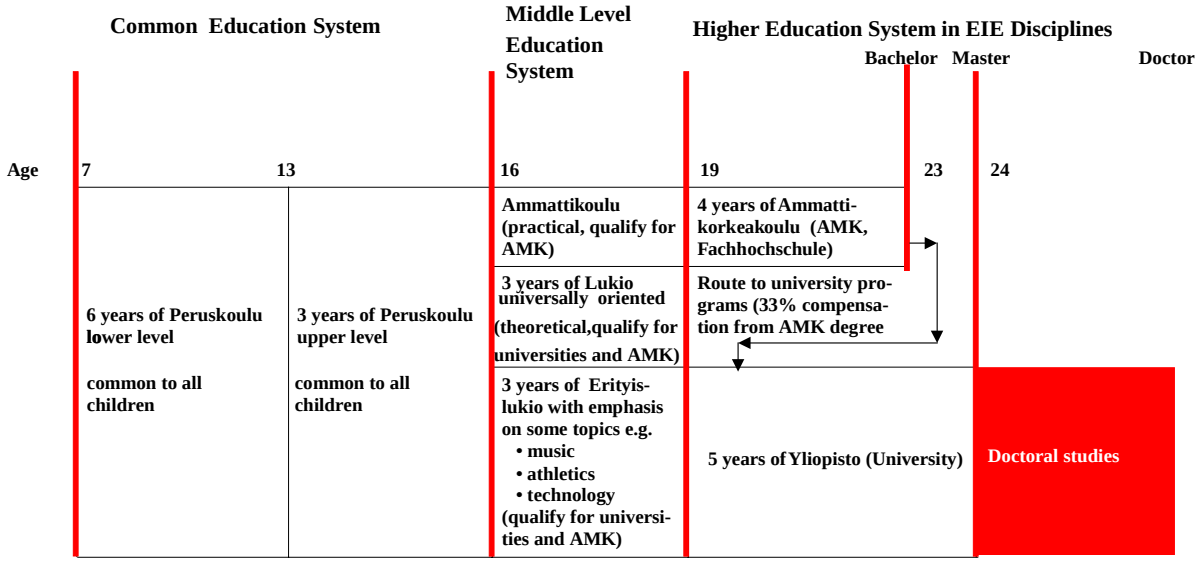

Figure 8.2: Finnish Education System

The Finnish higher education system comprises two parallel sectors: universities and polytechnics.

There are altogether 20 universities in Finland: ten multifaculty universities, three universities of technology, three schools of economics and business administration, and four art academies. Geographically, the network covers the whole country.

The basic mission of universities is to carry out research and provide education based on it. The underlying principle in university education is the freedom of research and university autonomy, which gives them extensive latitude for independent decisions. All Finnish universities are state -run, with the government providing some 70 % of their funding. Each university and the Ministry of Education conclude a three-year agreement on target outcome to determine the operational principles.

Universities select their own students, and the competition for openings is stiff. All fields apply "*numerus clausus*", in which entrance examinations are a key element. Universities offer openings for about one third of the age group. The annual number of new students is 23,000. The aim is to offer a place in universities and polytechnics to 60-65% of the age group, which will be achieved soon.

In the semesters 2001/2002 there were 162,785 university students in Finland, of whom 21,008 were postgraduate students. The share of engineering students was 21 %.

In March 1998, the Government adopted a programme to increase education relating to the information industry between 1998 and 2002. The programme has strongly increased

student enrolment in electrical and information engineering curricula. Around 50 % of new university students in engineering will be in the EIE sector.

All universities engage in both education and research and have the right to award doctorates. Master´s degree can generally be attained in five years of full-time study.

The polytechnics were established during the reform process of the 1990s, and now a network of 29 polytechnics covers the entire country. Most of these AMK institutions are multisector establishments. Former Technical institutes set up the basis for the Engineering Departments at the polytechnics. The number of students in the polytechnics in 2002 was 126,206. The share of engineering students was 33 % (42,088).

8.1.1 Electrical and Information Engineering in Finland, boundaries of the field of study

Electrical and Information Engineering has traditionally included all disciplines at Departments of Electrical Engineering (*Sähkötekniikka*). It means Power Engineering, Electronics, Automation and Systems Control, and Communications Engineering. In 1980's new Departments of Information Technology (*Tietotekniikka*) were launched. They mostly concentrate on Computer Science and Engineering, Communications Engineering and Software Engineering.

8.1.2 Content, degrees and accreditations

The extent of the degree programmes taken by the students is given in credit units (*opintoviikko*). One credit unit refers to an input of approximately 40 hours of work, which consists of lecture hours, exercises and other forms of instruction as well as independent work. The extent of a *diplomi-insinööri* degree is 180 credit units including M.Sc. thesis (20 credits). One credit unit equals 1,5 ECTS.

Each University has full autonomy to decide on the contents of each degree. The contents in EIE degrees have many options at each University. Study programmes consist of basic studies, general subject-related studies, advanced professional studies, personal studies and a Master's thesis.

Basic studies in engineering include mathematics, basic sciences and computer technology. After two years the studies become more subject-related. Students can choose specific study options within the degree programme. A Master's thesis is written during the final year of the studies.

Details of the contents of the study programmes are available on the websites of the Universities (see the list of References).

8.1.3 Implementation of the Bologna-BMD system in Finland

The new structure of degrees will be implemented by 1.8.2005.

Technical Universities and Engineering Faculties have appointed a working group to prepare the modifications needed for new degrees. There is some controversy regarding introducing the three year degree. However, the working group proposes a new degree of *Tekniikan kandidaatti* (Bachelor of Science in Technology) of 3 years duration. It is not considered a professional degree because of doubts to get professional recognition in industry. No changes are proposed for the content and time frame of the degree of *Diplomi-insinööri* (MSc in Engineering). Anyway the transfer from Finnish credits "*opintoviikko*" to ECTS will be implemented. The working group makes no recommendations on doctoral degrees.

In Polytechnics the only degree is the 4-year degree of *insinööri (AMK)*. The opinion of the Ministry of Education is that at present there exists no urgent need for the change to the Bologna-BMD system. The industries are satisfied with the 4-year degree as well.

8.2. Figures on the weight of EIE in Finland

In 2001/2002 there were 162,785 university students in Finland, of whom 21,008 were postgraduate students. The number of students in engineering was 34,190 (21 %).

The annual number of new students is 23,000. The aim is to offer a place in universities and polytechnics to 60-65% of the age group, which will be achieved soon.

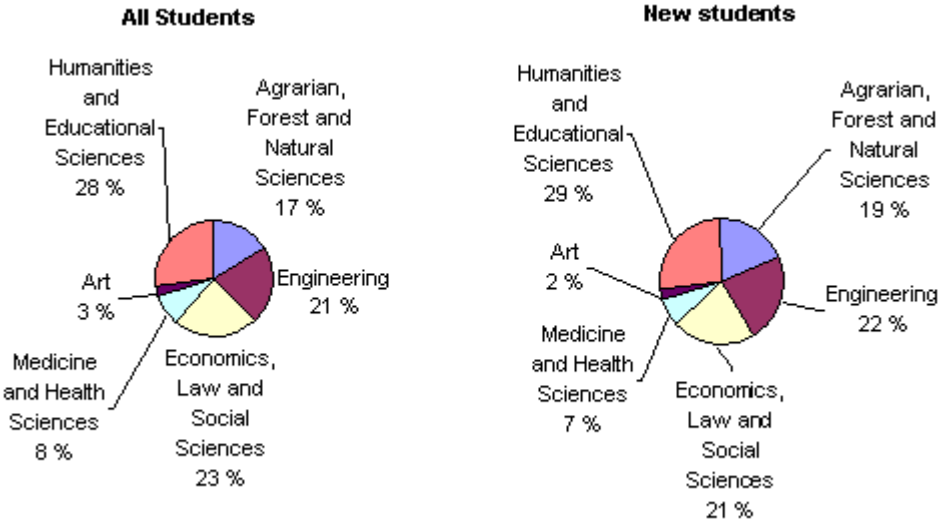

Figure 8.2: University students in 2001/2002

8.3. Degrees in EIE in Finland

All Technical Universities and Faculties of Technology offer Master's programmes in EIE of five years duration. The title of the degree is ***diplomi-insinööri*** **(*diplomingenjör*).**

There is also an optional pre-doctoral postgraduate degree of **tekniikan lisensiaatti (*teknologie licentiat*)**, which can be completed in two years of full-time study after the Master's degree. Full-time studies for a doctorate (***tekniikan tohtori, teknologie doktor***) take approximately four years following the Master's degree.

Polytechnic degrees are Bachelor-level higher education degrees with a professional emphasis and take 4 years to complete. The title of the degree is ***insinööri*** **(*AMK*)** or ***ingenjör*** **(*YH*)** in Swedish language *yrkeshögskola* institutions.

At present no higher-education degrees before the Bachelor-level exist.

8.4. References

The information given in this monograph is based on the following documents and web links:
http://www.minedu.fi/minedu/education/
http://www.hut.fi/English
http://www.lut.fi/english/
http://www.tut.fi/public
http://www.ttk.oulu.fi/English/
http://www.abo.fi/aa/engelska/

9. FR: France

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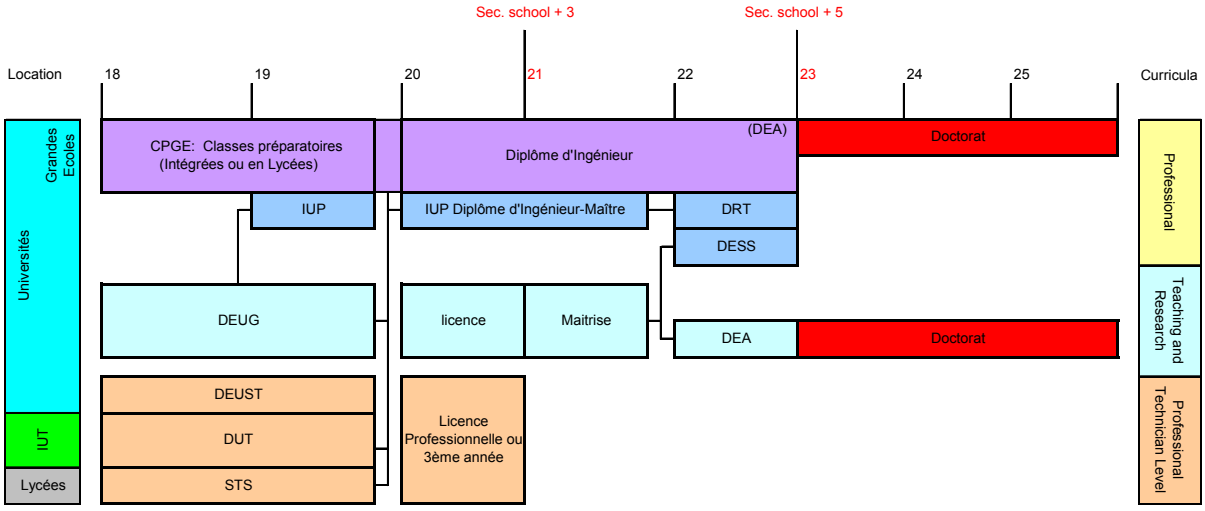
9.1. General information



CPGE : Classe Préparatoire aux Grandes Ecoles
DEUG : Diplômes d'Etudes Universitaires Générales
DEUST : Diplôme d'Etudes Universitaires Technologiques
DUT : Diplôme Universitaire de Technologie
BTS : Brevet de Techniciel Supérieur
STS: Section de Technicien Supérieur
IUP: Institut Universitaire Professionalisé

DEA : Diplôme d'Etudes Approfondies
DESS : Diplôme d'Etudes Supérieures Spécialisées

IUT: Institut Universitaire de Technologie
Licence Prof. : Licence Professionnelle

Figure 9.1: French Higher Education System in EIE disciplines in 2003[12]

9.1.1 Institutional point of view

In France, there are several kinds of academic institutions:

- Universities, which propose:
  - Classical curricula (begins with *DEUG*, followed by *licence* (bachelor), followed by *maîtrise*, then either industry-oriented *DESS* ("professional master") or research-oriented *DEA* ("research master") followed by *Doctorat* (PhD)), this system is evolving to a new BMD-compatible structure (not represented on the figure above), which is composed of a three-year *licence*, followed by a two-year master (either research-oriented or professional),
  - Professional curricula

[11] working group composed of other THEIERE members (Olivier Bonnaud (Rennes 1), Blaise Conrard (Lille), Denis Genon-Catalot (Valence), Michel Robert (Nancy 1), Georges Zissis (Toulouse 3)…) and Club EEA correspondents (Frédérique Bicking (Nancy 1), Yves Danto (Bordeaux 1), Bernard de Fornel (INPT, Toulouse), Philippe Hoppenot (Evry), Christophe Simon (Nancy 2)…) and also Patrick Lickel (Nancy 1), Mustapha Ouladsine (Aix-Marseille)
[12] Due to reviews on the present system in France, this scheme is evolving.

- ♦ Superior Technician level (*Diplôme Universitaire de Technologie (DUT)* prepared in *Institut Universitaire de Technologie (IUT)*),
- ♦ Industry-oriented bachelors ("*licence professionnelle*"),
- ♦ *Maîtrise* et *diplôme ingénieur-maître* (4 years after secondary school),
- ♦ Engineering schools (see below, master level) which prepare engineering graduation or diploma (*Diplôme d'Ingénieur*).

- Engineering schools
  - Classical engineering schools, which offer 3 year courses, basically after a "*classe préparatoire*" (2+3) (Grandes Ecoles),
  - Integrated engineering schools, in which most students obtain their engineer qualification after five years after the *Baccalauréat (Grandes Ecoles avec cycle préparatoire intégré)*.

Concerning engineering schools, it is interesting to notice that some of these belong to universities, with more or less autonomy relative to the University management team, whereas other engineer schools are completely independent, and are considered as universities (ability to deliver the Ph.D.).

- Secondary schools

Secondary schools (in French *lycées*) offer two kinds of academic studies:

- "*classe préparatoire*", which is a two-year preparatory period in order to prepare the student for an engineering school (Grande Ecole),
- STS ("*Section de Technicien Supérieur*") to prepare a student for a BTS ("*Brevet de Technicien Supérieur*"), Superior Technician level.

The degrees offered by "*lycées*" are not detailed in this study.

9.1.2 Degree points of view

- Diploma in order to enter into the academic level ("**Baccalauréat**"), at the end of secondary school
  In France, this diploma gives the right to enter into the academic system. Classical universities are open to any student, whereas in IUT, STS, Classes préparatoires and Ecoles d'ingénieurs, there is a "*concours d'entrée*" (entering examination).
- Before bachelor (sec. sch.+2)

Diploma (institution)	Selection to enter	Possibility to follow other studies after
Classes prépatoires (non academic)	Yes	Ingénieur
DEUG, DEUST	No	Licence-maîtrise or ingénieur
BTS, DUT	Yes	Licence-maîtrise or ingénieur

N.B. *BTS* and *DUT* are professional degrees, recognised by industry, most students don't follow studies after.

- Bachelor level (sec. sch.+3)

Diploma (institution)	Selection to enter	Possibility to follow other studies after
Licence or licence professionnelle	Yes	Maîtrise

N.B.: Some universities (Bordeaux, Perpignan…) now offer Bologna-conformed three-year bachelor degrees. Other French Universities will follow within the following next years.

- Curricula between bachelor and master (sec. sch.+4)

Diploma (institution)	Selection to enter	Possibility to follow other studies after
Maîtrise ou I.U.P.	Yes	DESS or engineer or DEA

- Master level (sec. sch.+5)

Diploma (institution)	Selection to enter	Possibility to follow other studies after
DEA	Yes	Doctorate (3 to 4 years)
DESS	Yes	
Engineer	Yes	Doctorate (3 to 4 years)[13]

N.B.: Some universities (Bordeaux, Perpignan…) now offer Bologna-conformed two-year master degrees (two years after the bachelor degree). Other French Universities will follow within the next four or five years.

- Doctorates

"short" doctorates ("*sec. sch.*" + 8 years)	"long" doctorates ("*sec. sch.*" + 12 to 13 years)
Thèse d'université	**Thèse d'Habilitation**

9.1.3 Electrical and Information Engineering in France, boundaries of the field of study

Traditionally in France, as in many other countries, there are two disciplinary fields:
- Electronics-Electrotechnics (power systems)-Automatic control (EEA) which corresponds to Electrical Engineering and Sciences,
- Informatics which corresponds to Computer Science and Engineering.

Presently, some changes are on the way, encouraged by the *CNRS (Centre National de la Recherche Scientifique* / National Centre for Scientific Research) which launched at the end of the nineties a new department called *STIC* (*Sciences et Technologies de l'Information et de la Communication* / Information and Communication Science and Technology)…

9.1.4 Content, degrees and accreditations

Depending upon the kinds of degrees, the pedagogical contents are:
- determined at a national level (national pedagogical programme) for the *DUT* for example,
- determined by each university autonomously but in fact with national concertations (*licence EEA*, or *IUP GEII* (*Génie Electrique et Informatique Industrielle*) for example)
- determined by each university autonomously, taking into account some local or regional specifics (for the determination of the contents of the *DESS*, *DEA* and engineering schools).

In France, the universities, which are autonomous, have to sign an agreement with the state every four years, taking into account the whole set of curricula proposed within the university.
The engineer schools (*Grandes Ecoles*) have a specific system, in which they are relatively free concerning the organisation and the contents of the curricula. However, to be recognised as an engineering school, they have to comply to some rules coming from the *Commission des Titres de l'Ingénieur* (Commission for the engineer titles). This *CTI* checks with periodic intervals whether each school respects the rules.

9.1.5 Implementation of the Bologna-BMD system in France

The universities which are presently preparing their new 4-year agreement with the state (minister of education) are negotiating, taking into account the Bologna-BMD process, and therefore proposing new curricula complying with the Bologna-BMD format.

[13] Depending on the school, normally a student in their last year of engineering should follow a "DEA" degree parallel to the last year of an "engineering" degree in order to follow on to a Ph.D.

9.2. Figures on the weight of EIE in France

In this part some global statistics on numbers of students in curricula in Electrical and Information Engineering are given. In the following part (9.3) of the document, there is a breakdown of these figures into specific degree specialities (see references in 9.4). The figures are from 1999 or 2000.

	Level of the degree	Total number of students	Number of students in the field of EIE	Percentage
Sup. Technician	BTS	94892	12298	12.96 %
	DUT	46701	10768	23.06 %
Bachelor	Licence professionnelle [14]	New degree in 2001		
"	Licence		3909	
"sec. + 4 y."	Maîtrise		3201	
	Maîtrise-IUP	8761	2534	28.92 %
Master	DEA		2240	
"	DESS	28885	4466	15.46 %
"	Diplôme d'ingénieur		9673	
"	Other master degrees		2187	

9.2.1 Other figures

In 2001, there were:

- 43948 scholars in scientific *classes préparatoires aux grandes écoles (CPGE)*, both in 1st and 2nd year.
- 63446 students in first year of university (DEUG sciences des structures et de la matière).

Some general statistics on students [Repères et références statistiques - édition 2001]
These figures are proposed per cycle:

- 1st cycle means 1st and 2nd year after secondary school (1st and 2nd year of bachelor)
- 2nd cycle means 3rd and 4th year after secondary school (3rd year of bachelor and 1st year of master)
- 3rd cycle means 2nd year of master

DUT and engineer schools are considered in these figures.

	1st cycle	2nd cycle	3rd cycle	Total
Law - political science	85737	62245	31128	179110
Economical sciences - management	69826	67549	24709	162084
Humanities - language sciences - arts	64759	43221	11648	119628
Foreign languages	78575	49551	6131	134257
Human and social sciences	100014	93605	33740	227359
Materials science and structures (math - physics-chemistry)	63446	27555	12503	103504
Science and technology - science for engineers	14340	62012	16865	93217
Nature and life sciences	38194	28890	15829	82913
Sports	25165	17903	1069	44137
Medecine - odontology	36340	23473	54299	114112
Pharmacy	10419	5085	10739	26243
Students in IUT	118829			118829

[14] This is a new curriculum available since 2001. Most students come from DUT or BTS, some from DEUG. Normally, this curriculum leads to industry. In 2001, there were **1100** students in these "*licences professionnelles*" (4400 students for all the "*licences professionnelles*").

TOTAL	*705644*	*481089*	*218660*	*1405393*

Students in Electrical and Information engineering are made up of the students studying "Material science and structure" and students studying "Science and technology - science for engineers", as well as 23.06 % (see figures above) of students in IUT.

9.3. Degrees in EIE in France

9.3.1 Before bachelor / Superior technician level (Sec. sch.+2)

9.3.1.1 *Diplôme Universitaire de Technologie (D.U.T.)* / Academic diplom of technology

Specialities (French)	**Specialities (English)**	*DUT* (1999)	Number of geographical sites	Keywords (EIE)	Keywords (beh. Skills)	Keywords (others)
Génie Electrique et Informatique Industrielle (GEII)	Electrical Engineering and Industrial Computering	4307	55	Electrical engineering (bet. 22.6 and 26%), industrial computers: Local networks (bet. 22.6 and 26%)	Communication (6%), English (6.2%) project (12%), training period (15.6%)	Maths, physics (11.4%)
Génie des Télécommunications et Réseaux	Telecommunication and Networks engineering	811	20	Electronics (10.4%), computers (12.8 %) Signal (1.6%) Telecommunications (9.2%) Networks (12.8%)	Communication (5%), English (5%), economy (2.4%) project (12%), training period (15.6%)	Maths, physics (13.2%)
*Services et Réseaux de Communication**	Communications services and Networks	386	20	Networks and communication systems (14.5%) Informatics (10.8%)	Communication (11.1%), Foreign languages (11.1%), Projects (12%) Training period (15.6%)	Communication, new technologies, multimedia (24.7%)
Informatique	Computers	3668	40			
*Organisation et Gestion de la Production**	Production Management and Organisation		21	Automatic control (4%), Production (30%) Computers (10%)	Communication (7%), English (7%), management (7%) project (10%), training period (18%)	Mechanics (7%)
*Mesures physique option techniques instrumentales**	Physical measurement Option "instrument technics"	1596	25	Electronics (8%), Metrology-Quality (3.6%) Automatic control (1%) Power systems (1%)	Communication (4%), English (4.4%), management (7%) project (7.2%), training period (15.6%)	Mechanics, therm., optics, chemistry, maths. (48.2%)
*Génie mécanique et Productique**	Production and Mechanical engineering			Electronics (4%) Automatic control (4.5%) Computers (2%)	Communication (5.4%), Foreign languages (5.4%), Economy (1.6%), Projects (4.5%) Training period (17.5%)	Mechanics, Production, Maths. (55.1%)
*Génie industriel et Maintenance**	Industrial engineering and maintenance			Electronics, power systems, automatic control, computers (21.3%), maintenance, in EIE (8.6%)	Communication (4.8%), Foreign languages (4.3%), Projects (12%) Training period (15.6%)	Maintenance in Mechanics, thermics, mecaniscs, therm., maths. (33.4%)
*Métrologie Contrôle Qualité**	Metrology, Quality control		1	Electronics (1.4%), Electricity (1.3%), Power systems (1.3%), Applied Physics (8,1%), Automatic control (3.3%), Instrumentation (4.7%)	Communication (5.2%), English (6.9%), Economy (1.9%), Projects (12.1%) Training period (15.5%)	Math (5.6%), Computers (6,3%), Prod. Tech. (9.2%), Metrology (8.7%), Quality (8.5%)
TOTAL	**TOTAL (DUT in EIE)**	**10768**				
TOTAL DUT	TOTAL (total number of DUT)	46701				
%	%	23,06				

*: By their characteristics, these degrees are on the border of Electrical and Information Engineering.

Comment: the IUT is administratively dependent on classical universities.

9.3.1.2 *Brevet de Technicien Supérieur (B.T.S.)* / Superior technician diploma

Specialities (French)	Specialities (English)	*BTS* (2000)	Number of geographical sites
Electronique	Electronics	1985	135
Electrotechnique	Power systems	3164	186
Domotique	Domotics	239	15
Génie optique option photonique	Optical engineering	133	9
Contrôle industriel et régulation automatique	Industrial control and automation	542	45
Informatique industrielle	Industrial computering	1343	104
Dévloppeurs application	Software development	1745	148
Administrateur de réseaux locaux d'entreprise	Administration of industrial local networks	1368	150
Audiovisuel (image, son, montage, exploitation)	Audiovisual (image, sound, mounting, exploitation)	561	47
Communication visuelle	Visual communication		44
Technico-commercial (génie électrique et mécanique)	Technics and business (electrical and mechanical engineering)	1218	87
TOTAL	**TOTAL (BTS in EIE)**	**12298**	
TOTAL BTS	TOTAL (total number of BTS)	94892	
%	%	12,96	

Comment: the BTS is administratively dependent on high schools ("*lycées*").

9.3.1.3 *Diplômes d'Etudes Universitaires Technologiques (D.E.U.S.T.)* / Diploma of technological academic studies

400 diploma given in 1999 in EIE. This is a marginal degree.

9.3.2 Bachelor (sec. sch. +3) level

9.3.2.1 *Licence scientifique* / Scientific bachelor

Specialities (French)	Specialities (English)	*Licence* (1999)	Number of universities
Electronique Electrotechnique Automatique (EEA)	Electronics- power systems - automatic control	841	17
Informatique, sciences cognitives	Computers, cognition sciences	2153	21
Ingénierie électrique	Electrical engineering	538	16
Physique et applications	Physics and applications	377	15
TOTAL	**TOTAL**	**3909**	

Comment: Most students come from DEUG, some come from DUT. Normally, most students continue in "maîtrise".

N.B.: Some universities (Bordeaux, Perpignan…) now offer Bologna-conformed three-year bachelor degrees. Other French Universities will follow within the next few years. In these curricula, students can follow their studies in a Bologna-conformed master.

9.3.2.2 *Licence professionnelle* / Professional bachelor

Specialities (French)	Specialities (English)	Licence professionnelle: number of universities
Informatique/Sciences et Technologies de l'Information et de la Communication/Télécoms réseaux	Computers/Information and Communication Science and Engineering / Telecommunications and networks	34
Electronique	Electronics	6
Commerce électronique	e-business	5
Automatique et informatique industrielle	Automation and industrial computering	4

This is a new curriculum available since 2001. Most students come from DUT or BTS, some from DEUG. Normally, this curriculum leads to industry. In 2001, there were **1100** students in these "*licences professionnelles*" (4400 students for all the "*licences professionnelles*").

9.3.3 Curricula between bachelor and master (sec. sch. +4)

9.3.3.1 *Maîtrise* / "Maîtrise"

Specialities (French)	Specialities (English)	maîtrise	Number of universities
Electronique Electrotechnique Automatique (EEA)	Electronics- power systems - automatic control	1230	19
Informatique	Computer	1544	21
Physique et applications	Physics and applications	427	15
TOTAL	**TOTAL**	**3201**	

This degree is only one year, normally after the "*licence*" which has the same name.

9.3.3.2 *Maîtrise de l'Institut Universitaire Professionalisé* or *Ingénieur-Maître* / "Maîtrise" from Professional academic institutes

Specialities (French)	Specialities (English)	Maîtrise IUP	Number of IUP
Génie Electrique et Informatique Industrielle (GEII)	Electrical Engineering and Industrial Computering	627	27
Génie des Systèmes industriels	Industrial systems engineering	403	12
Génie mathématique et informatique	Mathematical and computering engineering	589	22
Informatique de gestion	Management computering	806	-
Multimedia et internet	Multimedia and internet	109	8
TOTAL	**TOTAL (*IUP* in EIE)**	**2534**	
TOTAL	TOTAL (total number of "*maîtrise IUP*")	8761	
%	%	28,92	

Comment: *IUP* belongs to classical universities.
The degree duration is normally three years (2nd, 3rd and 4th year after sec. sch., that is after a 1st year of *DEUG)*.

9.3.3.3 *Maîtrise des Sciences et Techniques* / "*Maîtrise*" in Science and Technology

375 diploma were given in 1999 in EIE, by 16 universities.

9.3.4 Master level

9.3.4.1 *Diplôme d'Etudes Approfondies (DEA)*/ Diploma of Endeepen studies

Specialities (French)	Specialities (English)	DEA	Number of universities
Automatique, informatique industrielle, énergie électrique	Automation, industrial computering, electrical energy	353	12
Electronique, traitement du signal	Electronics, signal processing	781	17
Informatique	Computer	621	16
Télécommunications, réseaux, télédétection	Telecommunication, networks, teledetection	124	5
Systèmes d'information, communication	Information and communication systems	361	10
TOTAL	**TOTAL DEA in EIE)**	**2240**	

Comment: this diploma allows the student to follow with a Ph.D.
DEA is a one-year degree, normally followed after the "*maîtrise*" or "*maîtrise-IUP*".
N.B.: Some universities (Bordeaux, Perpignan…) now offer Bologna-conformed two-year master degrees (two years after the bachelor degree). Other French Universities will follow within few years. "Research-oriented" masters are proposed to replace the former *DEA*.

9.3.4.2 *Diplôme d'Etudes Supérieures Spécialisées (DESS)*/ Diploma of superior specialised studies

Specialities (French)	Specialities (English)	DESS	Number of universities
Automatique, électronique de puissance, informatique industrielle	Automation, power systems, industrial computering	521	13
Electronique, traitement du signal	Electronics, signal processing	494	14
Informatique	Computer	1843	21
Mathématiques appliquées, modélisation	Applied mathematics, modelling	504	
Télécommunications, réseaux	Telecommunication, networks	159	5
Systèmes d'information, communication	Information and communication systems	945	15
TOTAL	**TOTAL (DESS in EIE)**	**4466**	
TOTAL	TOTAL (total number of DESS)	28885	
%	%	15,46	

DESS is a one-year degree, normally followed after the "*maîtrise*" or "*maîtrise-IUP*".
N.B.: Some universities now offer Bologna-conformed two-year master degrees (two years after the bachelor degree). Other French Universities will follow within few years. Professional masters are proposed to replace the former *DESS*.

9.3.4.3 *Diplôme d'ingénieur* / Engineer diploma

	Where the students come from?			
	CPGE[1]	*DEUG* (university), *CPGE, DUT*[1]	*Baccalauréat*[2]	TOTAL
Specialised school or department (in EIE)	3506	1637	2319	7462
Schools or departments with options (in EIE)	1645	36	530	2211
TOTAL	5151	1673	2849	**9673**

Comments:

1: classical engineering schools, a three-year curriculum after two years of fundamental studies spent in *CPGE* (*Classe préparatoire aux grandes écoles* / prepatory class for engineering schools), or sometimes in classical universities (*DEUG Diplôme d'Etudes Universitaires Général* / General diploma of academic studies) or *DUT (Diplôme Universitaire de Technologie* / Academic diploma of technology).
2: integrated engineering schools, a five-year integrated curriculum after the *Baccalauréat*.
Other comments: in France, the title of "*ingénieur*" is given by the "*Ecoles d'ingénieurs*". These schools have a specific agreement with the "*Commission des Titres de l'Ingénieur C.T.I.*" / Commission for the title of engineer. Some "*Ecoles d'ingénieur*" depend on universities, others are independent, and are considered as universities (ability to deliver the Ph. D.).

9.3.4.4 Other diploma at the master level

Other diploma exists at the master level, in Electrical and Information Engineering but are marginal.

French name	English translation	Number of diploms given in 1999
Diplôme de Recherche Technologique (DRT)	Diplom of technological research	**97**
Magistère	"Magistère"	**154**
Mastère spécialisé	Specialised "master"	**1236**
Other private schools (non -recognised engineers)		**700**

9.4. References

The information given in this monograph is based on the following documents and web links:

- Diplômes délivrés dans les spécialités Electrotechnique, Electronique, Automatique; Communication et Informatique, bacc+2 à bacc +5, années de référence 1999 et 2000, CEFI, FIEEC,
- Ministère de l'enseignement supérieur,
- Website of CEFI : http://www.cefi.fr,
- Repères et références statistiques - édition 2001.

10. GR: Ελλάς (Greece)

Coordinating author: Gregory ZEIBEKAKIS (Technologhiko Ekpaideftiko Idryma Pirea, labsdm@hellasnet.gr)
Review: Jean-Marc THIRIET (Université Henri Poincaré Nancy 1,France)

10.1. General information

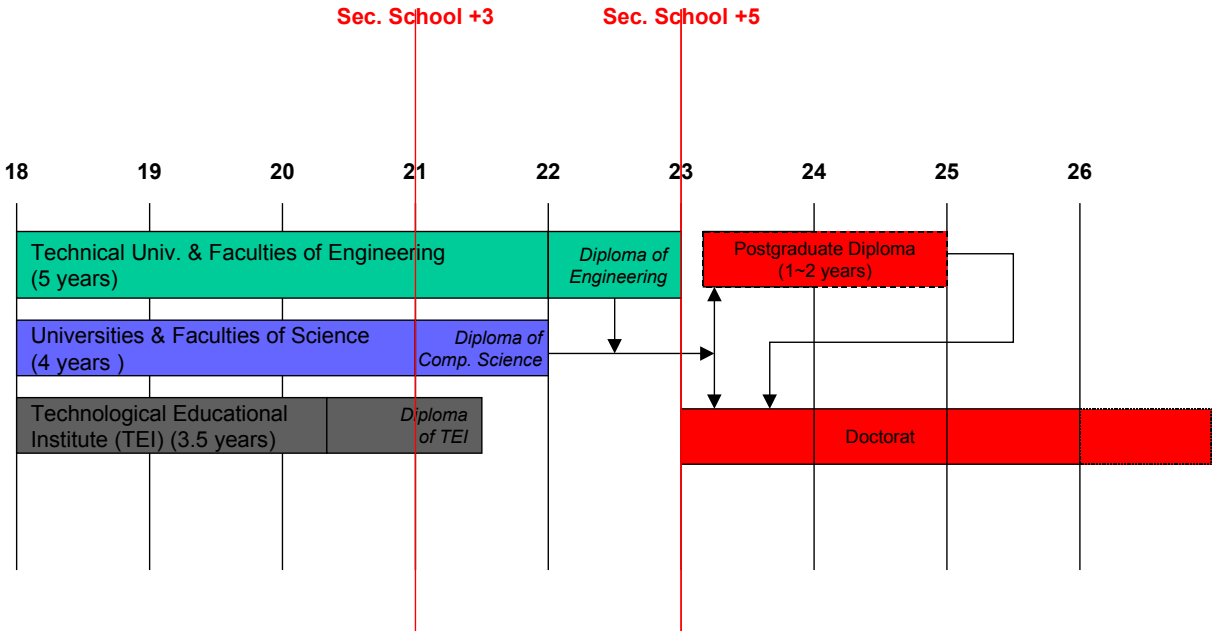


Figure 10.1: Greek Higher Education System in EIE disciplines

Higher education system in Greece consists of two types of institutes: Universities which are oriented in theory and TEI which are oriented more in practical skills. Entrance examinations are required for both.
Greece's 18 University institutions (AEI) and its 14 institutions of technological education (TEI) are self-governing and under the supervision of the Ministry of National Education and Religious Affairs which supports them financially and is responsible for educational policy concerning them.

Entrance requirements to the Institutions of Technological Education (TEI) are the same as for universities. Studies in TEI last for seven or eight semesters, including the compulsory professional placement and the completion of a graduation project, and lead to the Degree of Technological Education. Subjects include general compulsory subjects, mandatory elective subjects and optional subjects. The degree qualifies holders for immediate employment. It also allows them to continue their studies in a related university undergraduate course and, at postgraduate level.

Undergraduate degree programmes at universities normally last for four years (eight semesters) and lead to Degree in the relevant field. In Engineering studies last for ten semesters. The study programme contains compulsory and elective courses. Each semester, students are required to follow a number of compulsory courses consisting of the core programme and a number of elective courses. The total number of courses to be taken is decided by the respective course programme of the department. In some departments, the submission of a dissertation describing the final (graduation) project is required. For

example, the 10th semester of all Engineering Departments is devoted to the preparation of a final year project and the submission of a dissertation.

The first level of postgraduate studies, of duration of a minimum of four semesters, leads to (Postgraduate Diploma of Specialization Master Level). This study programme may be carried out and completed in a university or research institute outside Greece. The degree, however, is awarded in Greece.

There are sometimes some interdepartmental post-graduate programme Cooperation.

10.1.1 Electrical and Information Engineering in Greece, boundaries of the field of study

The usual way to refer to "Electrical and Information Engineering" in Greece is to refer as a specialization "*Electrologos Mechanikos ke Mechanikos Pliroforikis*" or "*Electrologos Mechanikos ke Mechanikos Ypologiston*" which is translated as "Electrical and Computer Engineering".

There are some departments that start courses with common subjects Electrical and Informatics and in the middle of the studies specializations split in Electrical or Computer Engineering.
The main orientations of EIE specialisations are: Electrical Engineering, Automation Engineering, Telecommunications, Applied Informatics, Electronics or Data communications Engineering.

10.1.2 Content, degrees and accreditations

Subjects taught are within the computer science, electrical and electronics fields. Subjects such as networks and telecommunications, programming languages, computer systems management, operating systems, peripheral units, systems of development of microcomputers, systems of automatic control and digital systems, Microelectronics and Robotic systems.
Also general subjects are taught like mathematics, physics and others.
The duration of the studies is seven, eight or ten semesters including the compulsory professional placement and the completion of a graduation project.

The Degrees of Electrical Engineers are also accredited by the Technical Chamber of Greece.

10.1.3 Implementation of the Bologna-BMD system in Greece

All the institutes (Universities and TEI) conform in the ECTS (European Credit Transfer System) and can accept students from abroad to carry out subjects within their studies. The implementation of the courses and the operation of the institutes converge to the mean European status. Though the application of the Bologna BMD system in Greece finds some implementation difficulties and will need some time to be completed. There are departments that provide bachelor degree and the duration of studies varies from 3,5 years to 5 years. At the moment a relevant report is not available but the department of the ministry which is responsible for that field will prepare a report that will contain also conclusions after the completion of the Greek presidency of the European Parliament.

10.2. Figures on the weight of EIE in Greece

Following, there are some figures apposed concerning the number of students that study in relevant subjects compared to the total number of students that study in each university. At the moment there are no figures available concerning the Technological Educational Institutes (TEI). In the Technological Educational Institutes the percentage of students that study in EIE is much more higher than of the Universities. TEI are oriented to applied subjects more than the Universities. So the percentage of students studying in EIE in TEI it might reach 30 percent of the total.

University/Department	**Number of students in department**	**Total number of students of Institution**	**Percentage in total number of students**
National and Kapodistrian University of Athens Dept of Informatics & Telecommunications	927	87.207	1%
National Technical University of Athens Dept of Electrical and Computer Science	1965	10.664	18,4%
Aristotle University of Thessaloniki Dept of Electrical and Computer Engineering Dept of Informatics	2173 391	90.788	2,8%
Athens University of Economics and Business Dept of Informatics	1052	21.781	4,8%
University of Piraeus Dept of Informatics	538	17.625	3%
University of Macedonia Dept of Applied Informatics	647	12.194	5,3%
University of Patras Dept of Electrical and Computer Engineering Dept of Computer Engineering and Informatics	1434 939	16.391	14,5%
University of Ioannina Dept of Informatics	296	11.916	2,5%
Democritus University of Thrace Dept of Electrical and Computer Engineering	907	13.462	6,7%
Technical University of Crete Dept of Electronic and Computer Engineering	438	1587	27,6%
University of the Aegean Dept of Information & Communication Systems Engineering	170	4927	3,45%
University of Thessaly Dept of Computer & Communication Enginnering	71	3.853	1,84%
TOTAL	**11948**	**292395**	**4,1%**

10.3. Degrees in EIE in Greece

10.3.1 Before bachelor (technician level)

The Higher Engineering Training College includes the following specialized departments: civil, mechanical, electrical and electronic engineering. Centres of Technical and Vocational Training (*KETEK*) offer short training courses (six to nine months) in over 20 fields. Specialized training is offered in certain areas. A recent Act of Parliament has established Institutes of Vocational Training (*IEK*). 14 have been set up in the major cities. They admit school leavers from *Gymnasia*, Technical-Vocational Schools and *Lykeia*. Training usually lasts for four semesters. A Certificate of Vocational Training which mentions the duration and specialization of the course is awarded following a final examination.

Technician level in Electronics: Radio and Television installations and maintenance, audio systems installation and repairs, electronic boards repair and installation, electronic appliances, automotive electronics, power electronics.
Technicial level in Telecommunications: telephone systems installation and maintenance, radio communications, maritime communications, satellite communications, wireless communications, electronics.
Technicial level in Automatic Control : Basic automation systems, industrial automation systems, automotive automation, marine automation systems, microcontrolers, PLCs.

10.3.2 Bachelor level

Bachelor degree programmes are designed to provide students with the knowledge and skills they will need to play a part in the future research, development and application of these technologies. The programmes are taught in Electronic, Electrical and Computer Engineering.
In the first two years students learn about a range of computer programming languages, computer networks, microprocessor-based systems, electronics and systems engineering. Depending on which programme they choose, they can also study computer systems, communication systems, computer speech and vision or mathematical techniques for signal processing. The following years give students opportunities to study more deeply the areas that particularly interest them. They undertake a major project and study advanced technical options.

Electronics – Produces a multi-skilled Technician with theoretical knowledge and practical experience
Topics: Electronics, Electrical and Electronic Principles, Experienced Methods, Engineering Applications, Systems Design, Microcontroler Systems, Power Electronics

Telecommunications - course which will enable graduates to enter the telecommunications engineering profession. It is designed to give students a thorough understanding of the theoretical and practical aspects of telecommunications. The course will prepare for the challenge of a continually changing environment of new concepts, systems and telecommunication services.
Topics: Signals & Systems, Telecommunications networks, Analogue & Digital Electronics, Broadband Communications, Transmission Technology, Network Components, Wireless communications, Satellite Communications.

Automatic Control - The courses in Automatic Control have been developed to meet the need for professionals who are able to respond to a rapidly changing technological and commercial environment, as well as the continuing demand from industry for graduates with a specialist knowledge of computer based control systems. Such systems are fundamental in our modern day way of life and arise in a variety of domestic, industrial, urban and natural environmental applications. Typical examples may be found in: aerospace, automotive and marine systems, refining, petroleum, chemical, food and pharmaceutical process industries, advanced automation, assembly and manufacturing industries, and in the optimisation, logistics and scheduling of transportation systems.
Topics: Automation systems, Industrial Automation, Vehicle Automation Systems, Marine Automation Systems, Microcontrolers, PLCs, Control Systems Design and Implementation, Industrial Control Networks, Engineering Systems Analysis, Non Linear Control Systems

10.3.3 Intermediate level, between bachelor and master

There is no intermediate level between Bachelor and Master Degree in Greece.

10.3.4 Master level

Master in Electronics: Audio Video Electronics, Power Electronics, Automotive Electronic Systems, Medical Electronic Systems, Microelectronics, Electronic Component Design.
Master in Telecommunications: Communication Networks, Data communications, Digital / Analog Communications, Management of Communication Networks, Telecommunication protocols, Standardisation, Telecommunications National Autorities policies and Strategies.
Master in Automatic Control: Industrial Automation, Aviation Automation, Marine Automation, Systems Design and Manufacturing, Telematics, Telematic Control Systems, Fuzzy Control Systems, Digital Signal Processing.

10.3.5 Other levels (Doctor)

The doctoral degree is conferred after the public defence of a thesis. The research must be original and show advances in research and science. A doctoral thesis requires at least three years' study since the student was admitted to doctoral studies. Students can be admitted to a doctoral research programme when they hold an undergraduate degree or Diploma or an equivalent qualification obtained abroad and recognized by *Dikatsa*. In certain university departments, students must also hold a Diploma of Postgraduate Specialization. This is the case when the department offers a postgraduate programme that is relevant to the doctoral research.

10.4. References

The information given in this monograph is based on the following documents and web links:
Book:
“Higher Education – Universities and Technological Educational Institutes”
Hellenic Republic, Ministry of National Education and Religious Affairs Edition 2003, Athens ISBN 960-87088-1-8
Websites:
Ministry of National Education and Religious Affairs: http://www.ypepth.gr
Euroeducation: http://www.euroeducation.net/prof/greece.htm

11. HU: Magyarország (Hungary)

Coordinating authors: Hamed YAHOUI (EAEEIE, Université Claude Bernard Lyon 1, France, yahoui@cegely.univ-lyon1.fr) and Csink LASZLO (EAEEIE, Polytechnics Budapest, csink@nik.bmf.hu)
Review: Cyril BURKLEY (EAEEIE, University of Limerick, Ireland)

11.1. General information

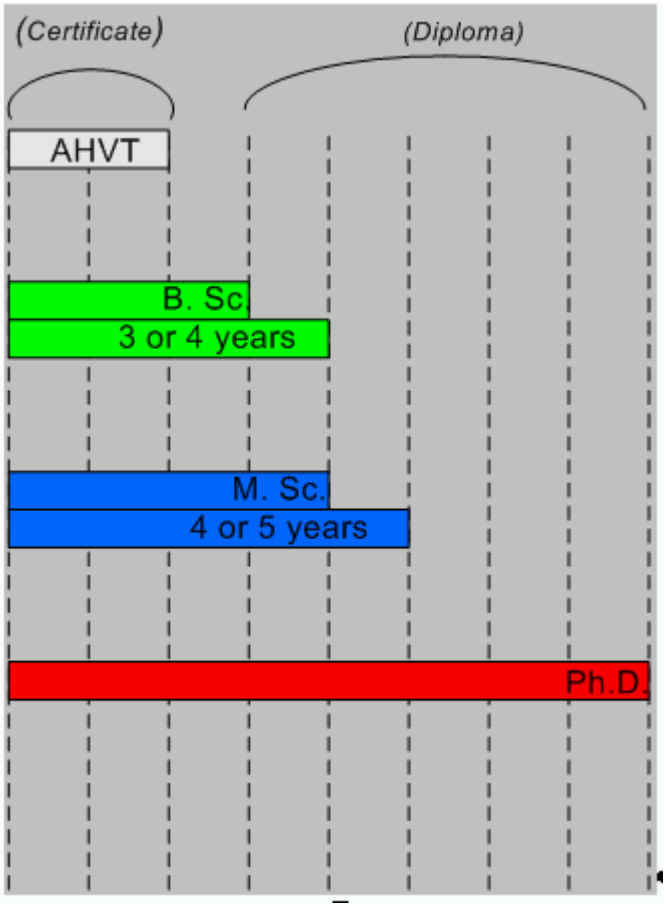


Figure 11.1: Hungarian Higher Education System in EIE disciplines

The closest concept to information engineering is *műszaki informatika* (technical informatics). This curriculum is closest to electrical engineering among all the informatics curricula. *Programozó matematikus* (programming mathematician) and *programtervező matematikus* (programme designing mathematician) curricula are also offered, mainly by Faculties of Natural Sciences, while the *műszaki informatika* (technical informatics) curricula are traditionally offered by technical universities and polytechnics.
The educational system of EIE in Hungary can be demonstrated most effectively by the comparison of the sequential and dual models (figure from Sima 2002):

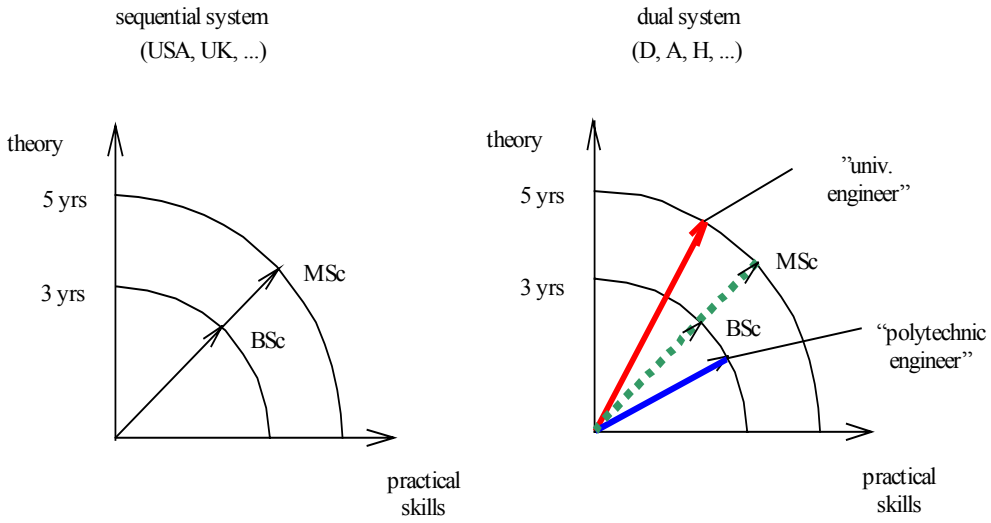


Figure 11.2: Hungarian sequential and dual systems

The Hungarian higher education has 2 kinds of systems, there are colleges and universities (University entry = Competitive entry based on examination), some colleges are associated with universities as college faculties of the universities. A university can offer college level courses, too.

Percentage of population participants at universities and colleges in full-time education with respect to the corresponding age: 17.4 % (1999). Number of higher education institutions are 62 (30 state, 26 church and 6 foundation institutions).

The Hungarian dual-type system of higher education in technology was established in the 1960s. Several polytechnics were founded in Budapest and other cities in Hungary, one for electronics, one for light industry, one for machine industry etc. These institutions were similar to the German *Fachhochschulen*, but the distance in research activities between universities and polytechnics was smaller in the Hungarian model than in the German one.

Polytechnics typically offered 6/7 semester long courses with the degree "polytechnic engineer" (see figure 11.2) while universities had 10 semester long courses ending with the degree "university engineering". The type of course thus matched the type of institution.

The 1980s brought about significant changes. Some universities, in order to attract more students, introduced the two-cycle model. However, polytechnics did not have the option of starting "univ. engineering" courses; their students having obtained a "polytechnic degree" were usually unable to enter the fourth year of a university without previously passing of several extra examinations.

In the following decade a new law of higher education was accepted by the Parliament (in 1993, modified in 1996). This made it possible for a polytechnic to start the "university engineer" degree if the necessary conditions were fulfilled, which were checked by the Hungarian Accreditation Board (in Hungarian MAB). Another important factor was the higher education integration programme in 2000. As a result, the number and ratio of universities and polytechnics has changed. Before 2000 there were many small polytechnics and a few universities, now we have several integrated universities and not so many integrated polytechnics.

The current era regarding the Bologna process is that of discussions and preparations. Some people think that the two-cycle system can be introduced very simply by cutting the 5-year long university curriculum in two parts: the first three years would be the BSc part, and the extra two years the MSc part. However, after 3 years the students typically do not get the necessary training to be able to get jobs at the labour market (too much theory, not enough skills). However, after the 3 years of polytechnic training the students typically do not have the necessary theoretical foundations to further study for the MSc (not enough theory, too much skill work). In this respect, some convergence between the "university engineering" and "polytechnic engineering" arrows would be optimal.

11.1.1 Electrical and Information Engineering in Hungary, boundaries of the field of study

EIE is Electrical and Information Engineering
Main specialities : Electrical Engineering, Process Engineering (for Wood material), Engineering of processing technology, Material Engineering, Computing and Information Systems, Information Technology, Electrical Engineering and Informatics, Engineering Physics.

11.1.2 Content, degrees and accreditations

Higher education institutions must be recognised by the government (the parliament) and are under the supervision of the Ministry of Education. There are state universities and colleges, higher education institutions controlled by various churches (dominantly by the Catholic Church) and private colleges. The Hungarian Accreditation Committee (HAC) give opinions on the establishment or recognition of higher education institutions, establishment or abolition of fields of study (courses).
Standards of higher education and quality endorsement of the education is based on the operation of HAC and Scientific Council. The agreement of both structures is necessary for introduction of a new course. Qualification requirements, curricula, quality of the academic staff, financial aspects and regional distribution of the trainings are taken into account.

Academic year **:** The academic year consists of two semesters, the fall semester starts in September. The spring semester in February until the end of May (for 14-15 weeks) followed by a period of exams (generally 6 weeks). The number of weekly contact hours in engineering courses is nearly 40 hours/week.

11.1.3 Implementation of the Bologna-BMD system in Hungary

The government has fixed some goals to be achieved :

- ✓ Higher educational institutions take into account the tasks related to the inevitable consequences of the accession of Hungary to the European Union,
- ✓ Introduction of the credit system in all higher education institutions.

11.2. Figures on the weight of EIE in Hungary

In 2003, 62000 students will be admitted to first year studies to all higher education institutes in Hungary. This includes all faculties, all universities and colleges, but the number refers to places only that are state supported. Regarding places without support (this number is surely less than the previous one) it is difficult to get aggregate data.
In informatics there are 5000 places in the first year, 2000 at universities, 3000 at colleges. I have to point out that the two/cycle training has not yet been introduced, though the process is going on. Thus these 2000 are pursuing an MSc, the 3000 a BSc.
In technical areas there are 3000 places for universities, 4500 for colleges. But these include all technical areas, special data just for electronics are not available in aggregate format, but you can have the details where the individual faculties are listed.
Source: Felsőoktatási felvételi tájékoztató, Oktatási Minisztérium, 2003. 06. 02.

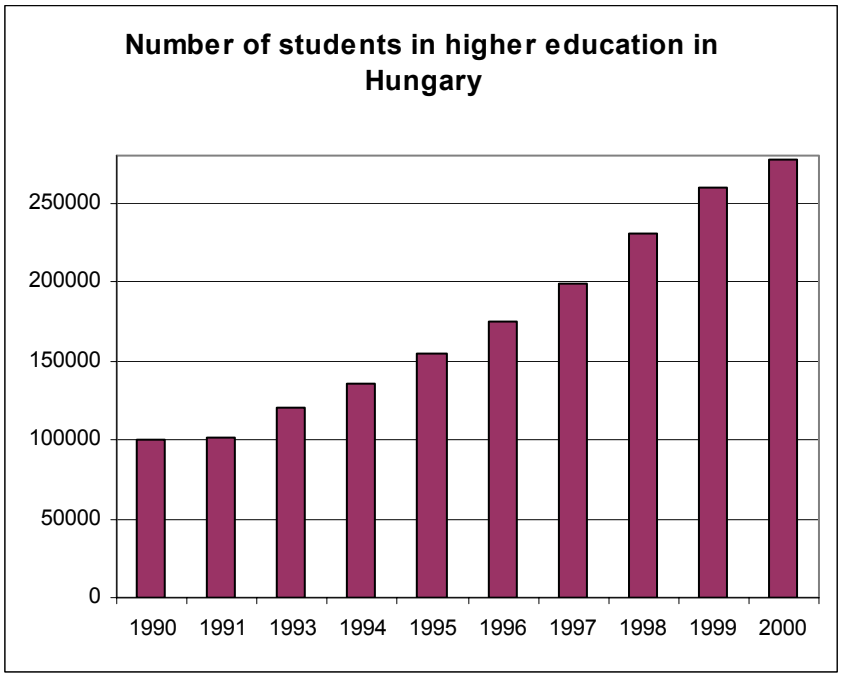


Figure 11.3: Number of students

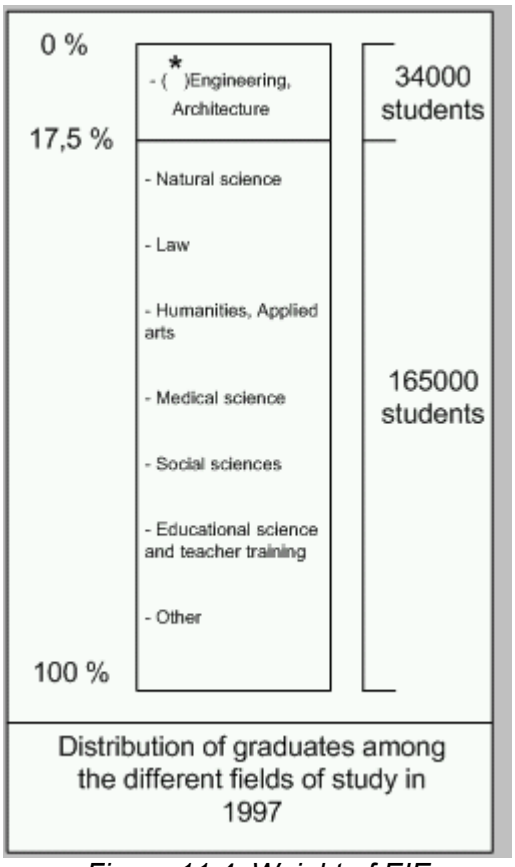


Figure 11.4: Weight of EIE

* There are less than 10 % of students in the field of Electrical and information engineering among the total of students in Engineering and Architecture field

11.3. Degrees in EIE in Hungary

Curricula at college level (corresponding to B. Sc. level) is a minimum of 3 years (undergraduate courses), maximum 4 years; Education at university level (corresponding to MSc. level) is minimum 4 years, maximum 5 years (graduate programmes). They are higher education institutions able to organise Ph.D. degree (post graduate) but their university professors should have Ph.D. degree and habilitation.
The higher education institutions can organise short-cycled courses in two year called Accredited Higher Vocational Training (AHVT). It is not a degree course, the graduates do not receive a diploma, but a certificate.

The entry to a curriculum requires an entrance exam whose result is combined (in a rather complicated way) with the results of the final examination at the secondary school forming points between 0 and 120. Additional points (up to 5) may be obtained if the applicant has a state-recognized language certificate of a foreign language. A minimum of 60 points must be reached for entry to any institution. The minimum entry requirement to a curriculum at a given institution depends on the number of available places and the quality of the applicants. If the minimum number is set at e.g. 100 it means that all applicants achieving 100 points or more are admitted and all applicants getting 99 or less are rejected. The minimum entry requirement in 2000 is listed after each curriculum to give an idea of its popularity among the students.
Only state-financed full-time curricula are listed which are offered as a first degree. The expression state-financed means that no tuition needs to be paid if a certain result is achieved by the student. Full-time means that the students typically do not have jobs during their studies. First degree means that the student does not yet have any degree from a higher educational institute.

11.3.1 Bachelor level

Degrees offered in *műszaki informatika szak* (technical informatics):

Institution code (min entry points)	No of semesters	No of 1st year students	Official name of institution
BMF-NIK (100)	6	330	Budapesti Műszaki Főiskola NIK
DE-MFK	6	60	Debreceni Egyetem MFK
DF (82)	6	300	Dunaújvárosi Főiskola
GDF (88)	6	400	Gábor Dénes Főiskola
KF-GAMFK (84)	6	324	Kecskeméti Főiskola GAMFK
ME-GÉK (95)	10	100	Miskolci Egyetem GÉK
PTE-PMMFK (82)	6	300	Pécsi Tudományegyetem PMMFK
SZE-MTK (87)	6	280	Széchenyi István Egyetem MTK
VE-MK (82)	6	60	Veszprémi Egyetem MK (Nagykanizsa)

Degrees offered in *programozó matematikus szak* (programming mathematician)

Institution code (min entry points)	No of semesters	No of 1st year students	Official name of institution
DE-TTK (73)	6	50	Debreceni Egyetem TTK
DE-TTK (73)	6	50	Debreceni Egyetem TTK
EKF-TTK (96)	6	40	Eszterházy Károly Főiskola TTK
ME-GÉK (73)	6	40	Miskolci Egyetem GÉK
SZTE-TTK (87)	6	80	Szegedi Tudományegyetem TTK

Degrees offered in *villamosmérnök szak* (electrical engineering):

Institution code (min entry points)	No of semesters	No of 1st year students	Official name of institution
BMF-KVK (77)	6	760	Budapesti Műszaki Főiskola KVK
DE-MFK (85)	6	30	Debreceni Egyetem MFK
ME-GÉK (79)	6	60	Miskolci Egyetem GÉK
PTE-PMMFK (78)	6	105	Pécsi Tudományegyetem PMMFK
SZE-MTK (81)	6	135	Széchenyi István Egyetem MTK
VE-MK (76)	6	65	Veszprémi Egyetem MK
ZMNE-BKMFK (60)	6	70	Zrínyi Miklós Nemzetvédelmi Egyetem BKMFK

11.3.2 Master level

Degrees offered in *műszaki informatika szak* (technical informatics):

Institution code (min entry points)	No of semesters	No of 1st year students	Official name of institution
BME-VIK (118)	10	460	Budapesti Műszaki és Gazdaságtudományi Egyetem VIK
PPKE-ITK (100)	10	150	Pázmány Péter Katolikus Egyetem ITK
SZTE-TTK (66)	10	100	Szegedi Tudományegyetem TTK
VE-MK (102)	10	160	Veszprémi Egyetem MK

Degrees offered in *programtervező matematikus szak* (programme designing mathematician)

Institution code (min entry points)	No of semesters	No of 1st year students	Official name of institution
DE TTK (79)	10	100	Debreceni Egyetem TTK
ELTE-TTK (62)	10	400	Eötvös Loránd Tudományegyetem TTK
SZTE-TTK (77)	10	100	Szegedi Tudományegyetem TTK

Degrees offered in *villamosmérnök szak* (electrical engineering):

Institution code (min entry points)	No of semesters	No of 1st year students	Official name of institution
BME-VIK (113)	10	413	Budapesti Műszaki és Gazdaságtudományi Egyetem VIK

11.4. Higher education - programmes in foreign languages in Hungary - 2002. Curricula in EIE

Institutions	BKÁE	BME	DE	ELTE	LFZE	KE	ME	PTE	SE	SZTE	SZIE	VE	BGF	MTF
Computing and Information Systems								•						
Information Technology												•♦		
Electrical Engineering and Informatics		•♦v♦•												
Geotechnical Systems and Process Engineering							v							
Material Engineering							♦							

Degree awarded: English • Bachelor ♦ Master v Ph.D. French • D.E.UG.

German • Fachhochschule diploma ♦ Universität diploma v Ph.D.

General information: Tuition fees/semester: Agriculture Sciences US$ 3000-4000/sem , Arts US$ 3000-4000/sem, Economics US$ 2700-4000/sem, Engineering US$ 2500-4000/sem, Medical Sciences US$ 4000-5000/sem, Natural Sciences US$ 2000-3000/sem.

Living expenses: In Hungary please add additional US$ 300-400/month for living (food, accommodation).

INSTITUTIONS

COURSES IN FOREIGN LANGUAGES (links)

University of PECS (Faculty of sciences) ➔ http://www.ki.pte.hu/courses.html#TTK
University of Veszprém ➔ http://www.vein.hu/mivoi/indexe.shtml
Budapest University of Technology ➔ http://www.tanok.bme.hu/bull9899/index.ssi
➔http://www.bme.hu/en/organization/faculties/electrical/index.html
University of Miskolc ➔ http://www.uni-miskolc.hu/uni/student/foreign/mie.html

11.5. References

The information given in this monograph is based on the following documents and web links:
Sima, D.: On the the two-cycle higher education in technology (Gondolatok a kétlépcsős műszaki felsőoktatásról, in Hungarian), © Magyar Akkreditációs Bizottság, 2002,
Source: Felsőoktatási felvételi tájékoztató, Oktatási Minisztérium, 2003. 06. 02.
http://www.mab.hu/doc/bologna.doc

Data regarding entry points etc. http://www.felvi.hu
http://www.om.hu/english
http://www.usc.edu/dept/education/globaled/wwcu/background/Hungary.htm

12. IE: Éire /Ireland

Coordinating author: Cyril BURKLEY (EAEEIE, University of Limerick, cyril.burkley@ul.ie)
Review: Raimund UBAR (EAEEIE, Tallinna Tehnikaülikool, Eesti (Estonia))

12.1. General information

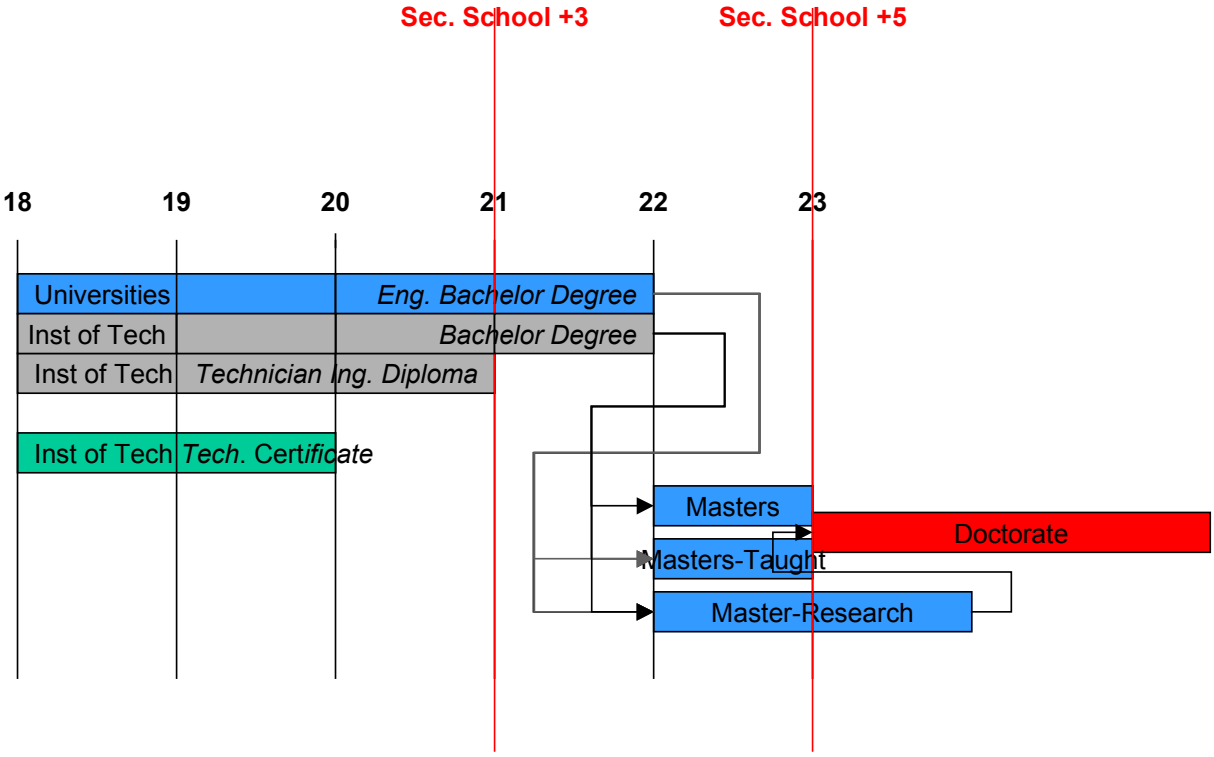


Figure 12.1: Irish Higher Education System in EIE disciplines

In Ireland, there are two kinds of institutions:

- Institutes of Technology,
- Universities.

12.1.1 Electrical and Information Engineering in Ireland, boundaries of the field of study

The Institution of Engineers of Ireland (IEI) covers all engineering disciplines and therefore there are no specific EIE "boundaries". Bachelor of Engineering programmes currently accredited in the EIE area include: Electrical Engineering, Electronic Engineering, Computer Engineering, Microelectronic Engineering and Telecommunications. Last year the Institution added programmes in software and Information Systems Engineering and as a result four B.Sc. programmes in Computer Science and Information Technology were added.

12.1.2 Content, degrees and accreditations

The Institution of Engineers of Ireland (IEI) has been designated as the national authority competent to regulate the engineering profession in the Republic of Ireland. This includes responsibility for evaluating the education and training of engineers and in fulfillment of this obligation the Institution formally accredits engineering degree programmes in Ireland.
The Institution of Engineers of Ireland do not review programmes for accreditation until after the programme produces its first cohort of graduates. Thus there are a number of other EIE

related programmes, which have commenced in the past few years and which, though not accredited at present, are likely to be accredited at the appropriate time in the future.
In addition there are a number of other B.Eng., B.Sc. and B.Tech. programmes in the EIE area offered by the Universities and particularly by the Institutes of Technology, which for a variety of different reasons have not been submitted for accreditation to the IEI.

The Institution of Engineers of Ireland gives some guidelines in relation to core content, which should include:
(i) Foundation Studies
Mathematics, basic sciences, basic engineering sciences and technology, computer technology

(ii) Engineering Studies
Engineering sciences and technology appropriate to the engineering discipline. Analysis, modelling, measurement, design and testing techniques in an appropriate range of subjects. Opportunities for specialisation and selected advanced study.

(iii) Complementary Studies
Communications skills, languages, industrial, social and environmental aspects of engineering.

However, even with these guidelines, the Universities still have a lot of freedom in defining the content and structures of their own programme. Details of the contents of each of the programmes can be obtained from the individual Universities, all of whom also have their own websites.

12.1.3 Implementation of the Bologna-BMD system in Ireland

The current Irish University education system is based on a four year primary degree. Therefore the current systems is a 458 (or possibility 469) system. The Universities are funded by the Government and currently students taking primary degrees pay no fees and therefore changing the Irish system to a Bologna-BMD system presents major problems.
Reducing the primary degree to three years will significantly reduce the level achieved by the graduates, which will have a negative knock-on effect for employers in business and industry. It would also require the Universities to redesign all of their existing programmes.
An alternative option is to increase the duration of the primary degree to 5 years, but this would have major funding implications for the Government and therefore is a decision that would require much prior discussion.
The Institution of Engineers of Ireland has reviewed the Bologna Declaration and its impact on Engineering education in Ireland and submitted its finding to the Government. Various other groups are still discussing the possible implications of moving towards the Bologna-BMD system.

12.2. Figures on the weight of EIE in Ireland

Student number figures for the Irish Universities for the Academic Year 2000/2001 showed that 4845 students (8.7%) out of a total of 55,729 students were studying EIE related programmes.

12.3. Degrees in EIE in Ireland

Degree programmes in Ireland are in general of four years duration. Students enter these programmes immediately after second level education at approximately 18 years of age. These programmes are offered by the Universities and in some cases by the Institutes of Technology.
Sub-degree programmes are also offered by the Institutes of Technology and other Third Level Colleges. These programmes include two year certificate programmes (Technician level) and three year Diploma programmes (Technician Engineer level) In some cases it is possible to progress from these programmes to degree programmes.
Taught Masters programmes, of one or two years duration, in a range of different subjects, are offered by most of the Universities. A Masters Degree can also be obtained by research and thesis (this typically takes 18 months to 2 years). Ph.D. degrees, which typically take a further three years, are offered by all the Universities.

12.3.1 Sub Bachelor Degree Level

In Ireland at Sub Bachelor Degree level, there are two recognised qualifications, a National Certificate and a National Diploma.

(a) A National Certificate in Engineering is a two-year ‘ab initio’ programme. The student effort required should be such as to merit 120 ECTS credits. On completion, the graduate is referred to as an Engineering Technician and should be competent to apply in a responsible manner proven techniques which are commonly understood by those who are expert in a branch of engineering or those techniques specially prescribed by professional engineers. He/she works under guidance within their allocated responsibility. National Certificate programmes are generally offered by the Institutes of Technology and programmes related to EIE currently on offer (see Section 12.1.1) include

Electronics –
(electronics 38%, maths 14%, telecommunications 7%, computers 8%, science 6%, technology 7%, projects and labs 8% and complementary studies 12%)

Electronic and Computer Engineering –
(electronics 25%, maths 14%, computers 34%, telecommunications 5%, science 3%, technology 7%, projects and labs 7% and complementary studies 5%)

Electronics and Communications –
(electronics 29%, maths 13%, computers 15%, telecommunications 18%, science 4%, technology 10%, projects and labs 7% and complementary studies 4%)

(b) A National Diploma in Engineering is a three-year ‘ab initio’ programme or a one year post National Certificate programme. The total student effort required should be such to merit 180 ECTS credits. On completion the graduate is referred to as an Associate Engineer and should be competent to apply in a responsible manner current engineering technologies in a chosen field. He/she exercises independent technical judgement and works with significant autonomy within his/her allocated responsibility. National Diploma programmes are generally offered by the Institutes of Technology and programmes currently on offer, related to EIE (Section 12.1.1) include:

Electronic Engineering –
(electronics 37%, maths 14%, telecommunications 6%, computers 12%, science 4%, technology 6%, project and labs 11% and complementary studies 10%)

Computer Engineering –
(electronics 20%, computers 38%, maths 14%. Science 4%, technology 6%, project and labs 10% and complementary studies 8%)

Mechatronics –
(maths 17%, electronics 21%, mechantronics 9%, computers 12%, science 9%, manufacturing 23%, project 9% and complementary studies 2%)

12.3.2 Bachelor level

The following is the current list of IEI accredited programmes in EIE:

- B.Eng Electronic Engineering (Cork IT, Dublin City University, University of Dublin, University of Limerick, NUI Galway)
- B.Eng Electrical/Electronic Engineering (Dublin IT, University College Cork, University College Dublin)
- B.Eng Electronic and Computer Engineering (University of Dublin, NUI Galway)
- B.Eng. Computer Engineering (University of Dublin, University of Limerick, DIT)
- B.Eng. Telecommunications Engineering (Dublin City University)
- B.Sc. Computer Science (Dublin City University, University of Dublin, University of Limerick)
- B.Sc. Information Technology (NUI Galway, University of Limerick)

Course content:

Electronic Engineering –
(maths 16%, science 5%, electronics 37%, computers 12%, telecommunications 10%, project 10% and complementary studies 10%)

Electrical/Electronic Engineering –
(maths 12%, science 3%, electronics 38%, computers 11%, telecommunications 9%, mechanical 6%, project and design 10% and complementary studies 7%)

Electronic and Computer Engineering –
(maths 16%, science 3%, electronics 6%, software 27%, computer systems 23%, project 10% and complementary studies 15%)

Computer Engineering –
(maths 11%, science 5%, electronics 22%, software 15%, computer systems 18%, telecommunications 7% project 10% and complementary studies 12%)

Telecommunications Engineering –
(maths 12%, electronics 28%, telecommunications 23%, computers 20%, science 4%, project 10% and complementary studies 3%)

Computer Science/Info Technology –
(maths 16%, software 20%, computer systems 18%, electronics 7%, science 3%, business 6%, telecommunications 8%, project 10% and complementary studies 12%)

Note – the individual Universities have the freedom to define and modify their own programmes and therefore the content percentages quoted above vary between the different Universities and also over time.

12.3.3 Intermediate level, between bachelor and master

In Ireland there is no formal level of qualification between the Bachelors Degree and the Masters Degree. However, many of the Universities offer Higher Diploma or Graduate Diploma programmes. These are generally of one year's duration (60 ECTS credits) and tend to be at degree level for graduates who already hold a degree in a related discipline. Therefore they are sometimes referred to as conversion programmes or double degrees. They also tend to be quite specialised with the title accurately reflecting the content and are usually unique to the University offering the programme.
The following is a list of the EIE related Higher/Graduate Diplomas currectly on offer–

Higher Diploma in Microelectronics – University College Cork

Graduate Diploma in Electronic Systems/Telecommunications Engineering – Dublin City University

Graduate Diploma in Software Localisation – University of Limerick

Graduate Diploma in Computer Engineering – University of Limerick

Graduate Diploma in Computing – University of Limerick

Higher Diploma in Software Engineering – NUI Maynooth

The individual Universities have the freedom to define and modify the contents of their programmes as opportunities arise and trends change.

12.3.4 Master level

Masters Degrees can be obtained either by Research and Thesis or by means of a taught programme and typically takes one to two years. A wide range of research topics, which relate to the research interests of the faculty and ongoing research projects are available at each of the Universities.
Similarly the Taught Masters programmes tend to reflect the research strengths of the University offering the programme and therefore they tend to be quite specialized in their content.
The following is a list of the EIE related Masters programmes currently on offer at the Irish Universities –

Microelectronic Engineering – University College Cork

Electronic Systems/Telecommunications Engineering – Dublin City University

Networks and Distributed Systems – Trinity College Dublin

Multi media Systems – Trinity College Dublin

Computer and Communications Systems – University of Limerick

VLSI Systems – University of Limerick

Interactive Media – University of Limerick

Software Localisation – University of Limerick

Software Engineering – NUI Maynooth; Athlone Institute of Technology

The individual Universities have the freedom to introduce new programmes or to modify existing programmes as opportunities arise and trends change.

12.3.5 Doctorate Level

The Doctorate or Ph.D. degree is the highest-level degree normally awarded by the Universities in Ireland. It is typically taken after the Masters degree and generally is of three years duration. In the EIE disciplines it is always taken by research and thesis and as with the Research Masters a wide range of research topics, which related to the research interests of the faculty and ongoing projects are available at each of the Universities.

12.4. References

The information given in this monograph is based on the following documents and web links:

- Institution of Engineers of Ireland, which is the professional engineering body in Ireland. The web address is http://www.iei.ie/

13. IT: Italia (Italy)

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Other contribution: Cristian PERRA (Università degli Studi di Cagliari, cperra@diee.unica.it)
Review: Jorge ESTEVES (EAEEIE, Instituto Superior Técnico, Lisboa, Portugal)

13.1. General information

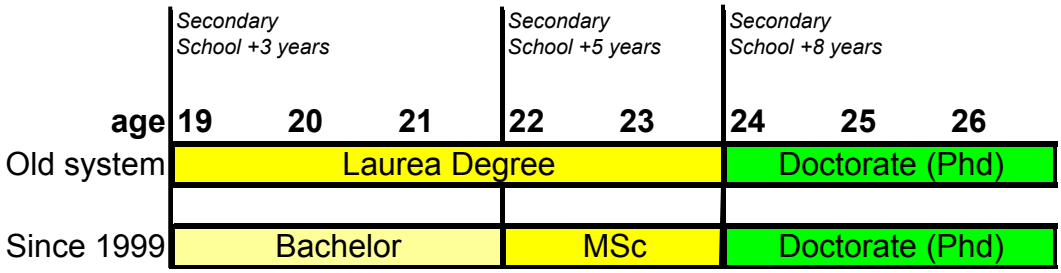


Figure 13.1: Italian Higher Education System in EIE disciplines

Italian students have access to EIE University courses if they have completed a five year secondary school. Each University has its own courses and subjects. "*Laurea di primo livello*", "*Laurea specialistica*" and "*Dottorato di Ricercerca*" are, respectively, the Italian terms for "Bachelor", "MSc" and "Doctorate".

13.1.1 Electrical and Information Engineering in Italy, boundaries of the field of study

The subjects present in Italian universities are:

- Electrical engineering
- Electronic engineering
- Computer sciences engineering
- Telecommunication engineering
- Bio-Medical engineering
- Automation engineering
- Information engineering
- Computer science and automation engineering
- Management engineering
- Computer science and bio-medical engineering
- Computer science and telecommunication engineering
- Physics engineering
- Mathematical engineering
- E-business engineering

13.1.2 Content, degrees and accreditations

In Italy, each University manages each degree course (Bachelor, Master, Doctorate) through the relevant council of professors (one for each course of studies), who define a curriculum, following some basic rules issued by the Italian Minister of University. The curriculum has then to be approved by the relevant Faculty.

13.1.3 Implementation of the Bologna-BMD system in Italy

In Italy, the Bologna-BMD organization has been active since 1999, overlapping the old organization (5-8) till 2003 or later (depending on when each University adopted this reform). Of course, students that did prefer not to change the organization of their studies, will be able

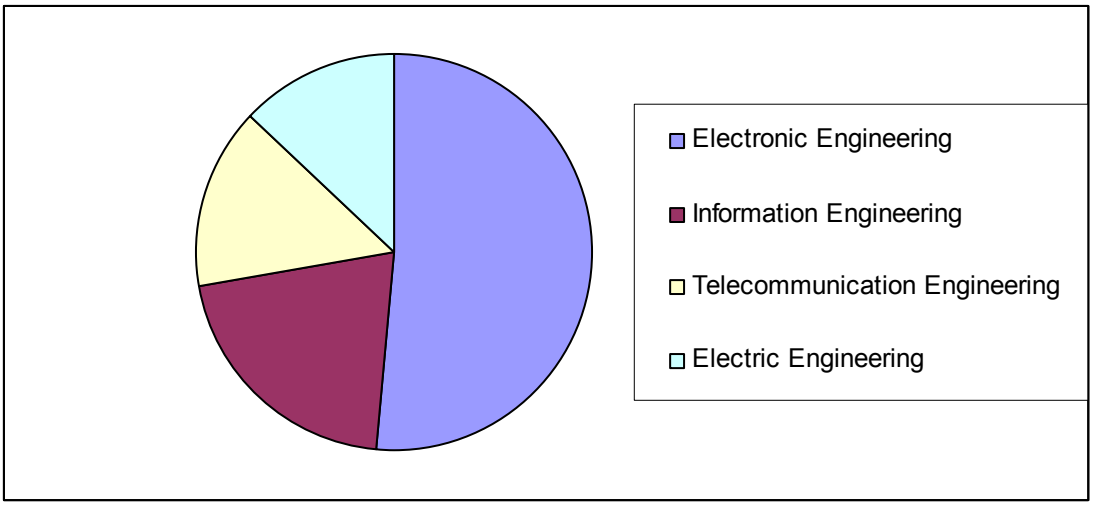
to graduate also in the future, in the sense that no teaching activities will be provided for them after five years from adoption of the reforms, but they will be allowed to do exams.

13.2. Figures on the weight of EIE in Italy

Detailed statistics on Italian universities are on line available at the Ministry of Education, University and Research web site (http://www.miutr.it/ustats).

The following table shows the number of MSc degrees in Italy for the year 2001.

	Absolute value	
Electronic Engineering	1.349	51,45%
Information Engineering	545	20,79%
Telecommunication Engineering	385	14,68%
Electric Engineering	343	13,08%
Total	**2.622**	**100,00%**



13.3. Degrees in EIE in Italy

Since 1999 the degrees in EIE are based on the new Bologna-BMD scheme. Bachelor is a title given by Italian universities after the completion of 6 semester of courses. In order to obtain such a title, students must accumulate a total of 180 credits from courses, thesis and other related activities approved by the University. MSc is a title given by Italian universities, after the completion of another 4 semesters where the students must reach a total of 300 credits (180 from the first three years and 120 in the last two years).

The reference for the following courses and institution can be found in: http://www.miur.it/.

A	**Automation engineering**
B	**Bio-Medical engineering**
C	**Computer science and automation engineering**
D	**Computer science and bio-medical engineering**
E	**Computer science and telecommunication engineering**
F	**Computer sciences engineering**
G	**E-business engineering**
H	**Electrical engineering**
I	**Electronic engineering**
J	**Information engineering**
K	**Management engineering**
L	**Mathematical engineering**
M	**Physics engineering**
N	**Telecommunication engineering**
O	**Computer science and electronic**
P	**Management and information engineering**

13.3.1 Bachelor level

Bachelor in Automation engineering
Bachelor in Bio-Medical engineering
Bachelor in Computer science and automation engineering
Bachelor in Computer science and bio-medical engineering
Bachelor in Computer science and telecommunication engineering
Bachelor in Computer sciences engineering
Bachelor in E-business engineering
Bachelor in Electrical engineering
Bachelor in Electronic engineering
Bachelor in Information engineering
Bachelor in Management engineering
Bachelor in Mathematical engineering
Bachelor in Physics engineering
Bachelor in Telecommunication engineering
Bachelor in Computer science and electronic
Bachelor in Management and information engineering

13.3.2 Master level

Master in Automation engineering
Master in Bio-Medical engineering
Master in Computer science and automation engineering
Master in Computer science and bio-medical engineering
Master in Computer science and telecommunication engineering
Master in Computer sciences engineering

Master in E-business engineering
Master in Electrical engineering
Master in Electronic engineering
Master in Information engineering
Master in Management engineering
Master in Mathematical engineering
Master in Physics engineering
Master in Telecommunication engineering
Master in Computer science and electronic
Master in Management and information engineering

13.4. References

The information given in this monograph is based on the following documents and web links:
http://www.miur.it/, Ministry of Education, University and Research
http://www.miur.it/ustat/, Ministry of Education, University and Research
http://almalaurea.cineca.it/universita/profilo/profilo2001/dati/laureatiper_cdl.html

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Review: Silvia STEFANOVA (EAEEIE, University of Rousse, Balgarija)

14.1. General information

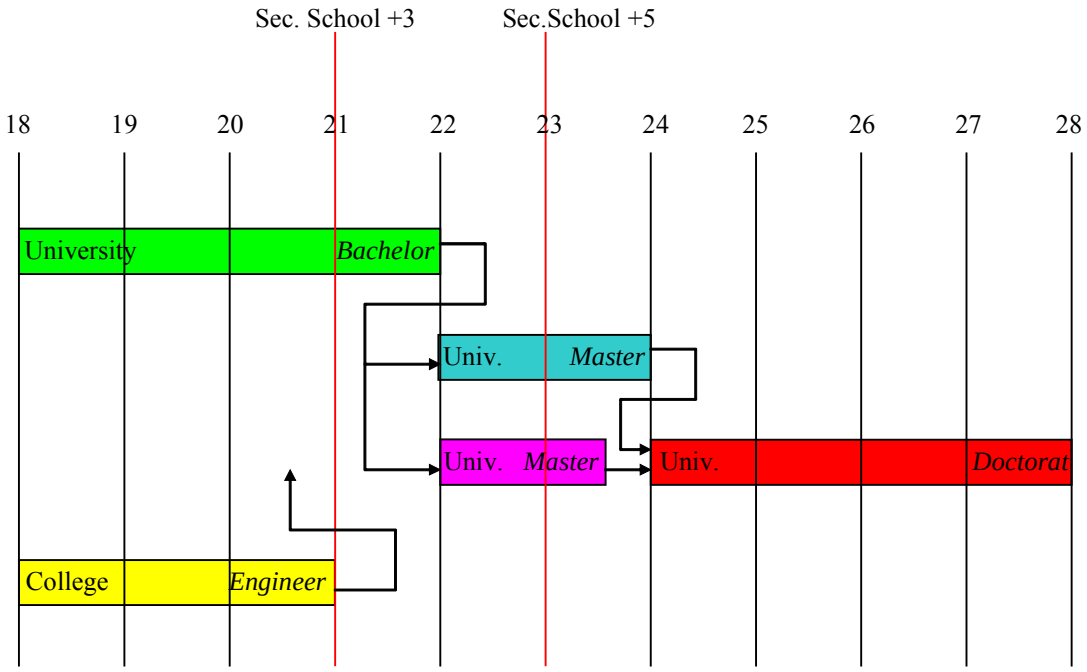

Figure 14.1: Lithuanian Higher Education System in EIE disciplines

Higher education is divided into undergraduate, graduate, and doctoral studies. Universities award Bachelor's, Master's and Doctor's degrees.
Undergraduate studies (160 credits = 240 ECTS credits) lead to a Bachelor's (*Bakalauras*) degree. Master's (*Magistras*) degree is awarded for an individual who has received a Bachelor's degree and conducted the 60 to 80 credits study programme in one and a half or two years, acquiring a special training and skill for research.
The Doctor of Science (*Mokslų daktaras*) degree (D.Sc), which equates with a Ph.D., takes a further three or four years to acquire and is only awarded to those whose research provides a significant and original contribution in the selected field.
Higher non-university technical education is offered in colleges. Technical colleges award Engineer's degree (*Inzinierius*) (120 credits = 180 ECTS credits).
The academic year consists of an autumn and spring semester.
The autumn semester starts on September 1 for 16 weeks followed by Christmas vacation and four weeks winter exam session.
The spring semester starts at the beginning of February for 16 weeks with four weeks spring exam session.
The basic unit of a study programme is a course module. It may involve various forms of study: lectures, laboratory work, practice, tutorials, seminars, independent study, research, projects, other work or a combination of some of these. The duration of a course module is one semester.
The measure of a course module and all course plans is a credit. One credit corresponds to 40 hours of a student's work.

Two credits are equivalent to 3 ECTS credits.

14.1.1 Electrical and Information Engineering in Lithuania, boundaries of the field of study

- Electrical Engineering,
- Electronics Engineering,
- Information Engineering.

14.1.2 Content, degrees and accreditations

The guidelines for higher engineering education study programmes are defined by legislation.
The study programmes are developed by universities and registered at the Department of Science and Higher Education of Lithuanian Republic.
The Lithuanian Centre for Quality Assessment in Higher Education is in charge for the quality of study programmes.
The study programmes should be available on the web sites of the universities.

14.1.3 Implementation of the Bologna-BMD system in Lithuania

This is presently being discussed.

14.2. Figures on the weight of EIE in Lithuania

** see the list of universities given in appendix A*

Enrolment for the academic year 2002/2003

Engineer

Engineering	VK	KTK	KVTK	SK	KK	Total	%
Electrical	-	60	60	60	-	180	37.50
Electronics	120	30	-	-	-	150	31.25
Information	90	-	-	-	60	150	31.25
Total	210	90	60	60	60	480	100

Bachelor

Engineering	KUT	VGTU	KU	SU	VU	Total	%
Electrical	422	85	20	47	-	574	40.45
Electronics	355	239	-	47	29	670	47.22
Information	175	-	-	-	-	175	12.33
Total	952	324	20	94	29	1419	100

Master

Engineering	KUT	VGTU	KU	SU	VU	Total	%
Electrical	121	18	8	-	-	147	27.37
Electronics	131	52	-	10	6	199	37.06
Information	191	-	-	-	-	191	35.57
Total	443	70	8	10	6	537	100

.

	Universities, Colleges	Engineering	EIE
Engineer	10200		480
Bachelor	27500	5130	1419
Master	8000	1660	537

14.3. Degrees in EIE in Lithuania

14.3.1 Engineer (technician) level

Engineer (non-university higher education, three years after secondary school)

- *Electrical Engineering*
  Electrical Engineering (KVTK, SK) :
  Electric Power Engineering (KTK, SK)
- *Electronics Engineering*
  Electronics Engineering (KTK, VK) :
  Telecommunications (VK)
  Computer Engineering (VK, KK)
- *Information engineering*
  Computer Programming (VK).

14.3.2 Bachelor level

***Bachelor** (four years after secondary school) in:*

- *Electrical Engineering*
  Electrical Engineering (KTU, KU) : Mathematics/Natural Sciences 25 %, Informatics 5 % Circuits/Systems 18 %, Control/Automation 14 %, Power systems 7 %, Computers/Programming 6 %, English 5 %, Economics/Management 5 %, Projects 10 %, Industrial training 5%.
  Automation and Control (KTU, VGTU): Mathematics/Natural Sciences 25 %, Informatics 5 % Circuits/Systems 18 %, Automation/Automation 16%, Power systems 3 %, Computers/Programming 8 %, English 5 %, Economics/Management 5 %, Projects 10 %, Industrial training 5 %.
- *Electronics Engineering*
  Electronics Engineering (KTU, VGTU, SU) : Mathematics/Natural Sciences 25 %, Informatics 5 % Circuits/Signals/Systems 20 %, Electronics 12 %, Computers/Programming 7 %, Electrodynamics 6%, English 5 %, Economics/Management 5 %, Projects 10 %, Industrial training 5 %.
  Telecommunications (KTU, VGTU) : Mathematics/Natural Sciences 25%, Informatics 5 % Circuits /Signals/Systems 15 %, Electronics 8%, Electrodynamics 4 %, Computers/Programming 8 %, Telecommunication/Networks/Ptotocols 12 %, English 5 %, Economics/Management 5 %, Projects 8 %, Industrial training 5%.
  Telecommunication Physics and Electronics (VU) : Mathematics/Natural Sciences 35 %, Informatics 5 % Circuits/Signals/Systems 10 %, Electronics 7 %, Electrodynamics 6 %, Telecommunication 12 %, English 5 %, Economics/Management 5 %, Projects 10 %, Industrial training 5 %.
- *Information Engineering*
  Information Technologies (KTU, SU) : Mathematics/Natural Sciences 25%, Informatics 5 %, Circuits/Electronics 6 %, Programming 12 %, Computers/Networks/Systems 30 %, English 5 %, Economics / Management 5 %, Projects 12 %.

14.3.3 Master level

Master (two or one and a half years after bachelor level) in:

- *Electrical Engineering*
  Electromechanics,
  Electric Power Engineering,
  Process and Systems Control,
  Control Technologies,
  Illuminating Engineering,
  Power Electronics (KTU),
  Automation,
  Aviation Electrical Engineering (VGTU),
  Industrial Electrical Engineering (KTU, SU, KU).

- *Electronics*
  Applied Electronics,
  Electronics Technology,
  Telecommunication Systems,
  Metrology and Instrumentation (KTU),
  Electronics Engineering
  Telecommunications (KTU, VGTU, SU),
  Telecommunication Physics and Electronics (VU).
- *Information Engineering*
  Information Technologies (KTU, VGTU),
  Software Engineering (KTU).

14.3.4 Doctor level (three or four years after master level)

- *Electrical and electronics engineering*
- *Information Engineering*

14.4. References

The information given in this monograph is based on the following documents and web links:
http://www.mokslas.lt
http://www.ktu.lt
http://www.vtu.lt
http://www.vu.lt
http://www.su.lt
http://www.ku.lt
http://www.ktk.lt
http://www.viko.lt
http://www.kazum.lt
http://www.siauliukolegija.lt
http://www.klk.lt
http://www.inf.vtt.fi/pdf/tiedotteet/2002/T2169.pdf

15. LU: Luxembourg

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15.1. General information

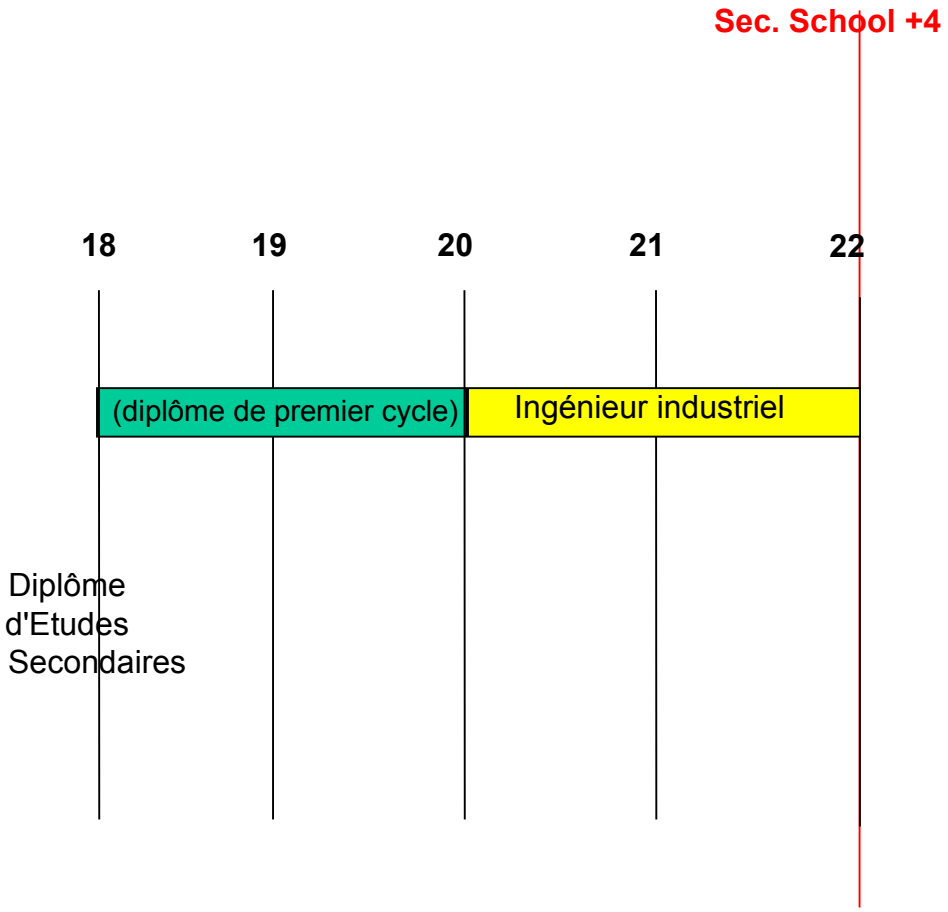

Figure 15.1: Luxembourg Higher Education System in EIE disciplines

In Luxembourg, the "*Diplôme de fin d'études secondaires* (diploma of end of secondary school)" or "*diplôme de fin d'études secondaires techniques* (diploma of end of technical secondary school)" allows the student to enter *IST* (*Institut Supérieur de Technologie/Fachhochschule Luxemburg* (Luxembourg university of applied sciences)).

"End of secondary school"
Diplôme de fin d'études secondaires *Diplôme de fin d'études secondaires techniques*

Diplôme de 1er cycle (end of secondary school + 2 years)

Diploma (institution)	Possibility to follow other studies after	Selection to enter
Diplôme de 1er cycle	*Ingénieur Industriel*	No

Diplôme d'ingénieur industriel (end of secondary school + 4 years)

Diploma (institution)	Possibility to follow other studies after	Selection to enter
Diplôme d'ingénieur industriel		Yes

15.1.1 Electrical and Information Engineering in Luxembourg, boundaries of the field of study

Since IST is presently the only HE institution in Luxembourg, the "boundaries" of Electrical and Information Engineering are given by the degrees proposed by IST. There are degrees in applied informatics, software engineering, networks and distributed systems, new media, micro-electronics, telecommunications, automation, power systems…

15.1.2 Content, degrees and accreditations

Since the IST is the one and only HE institution in Luxembourg, it is autonomous and defines the contents of its curricula by itself.

15.1.3 Implementation of the Bologna-BMD system in Luxembourg

Some discussions are presently being held in partnership with other universities in Belgium, Germany and France within a global regional programme (SarLorLux), and also for the organisation of a university in Luxembourg. These discussions are also linked with the Bologna-BMD reflections.

15.2. Degrees in EIE in Luxembourg

15.2.1 Diplôme de premier cycle

- Diplôme de premier cycle en Informatique appliquée (*Diploma of first cycle in Applied informatics*
- Diplôme de premier cycle en Electrotechnique (*Diploma of first cycle in Power systems*)

15.2.2 Diplôme d'Ingénieur industriel

- *Diplôme d'ingénieur industriel en Ingénierie des Systèmes d'information et génie logiciel (*Diploma of industrial engineer in Software and information systems engineering)
- *Diplôme d'ingénieur industriel en Ingénierie des Réseaux et Systèmes distribués (*Diploma of industrial engineer in Networks and distributed systems engineering))
- *Diplôme d'ingénieur industriel en Ingénierie des Systèmes d'Information en Nouveaux Média* (Diploma of industrial engineer in Engineering of information systems for new media)
- *Diplôme d'ingénieur industriel en Ingénierie des Systèmes microélectroniques (*Diploma of industrial engineer in Micro-electronics system engineering)
- *Diplôme d'ingénieur industriel en Techniques des Télécommunications (*Diploma of industrial engineer in Telecommunication techniques)
- *Diplôme d'ingénieur industriel en Techniques de l'Energie Electrique et de l'Automatisation* (Diploma of industrial engineer in Techniques for Electric Supply and automation)
- *Diplôme d'ingénieur industriel en Automation, Mécatronique (*Diploma of industrial engineer in Automation, Mechatronics)

15.3. References

The information given in this monograph is based on the following documents and web links:
Guide des études / Studienführer 2001/2002 - Institut Supérieur de Technologie/Fachhochschule Luxemburg/ Luxembourg University of Applied Science, Luxembourg, 2001.

16. LV: Latvia

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16.1. General information

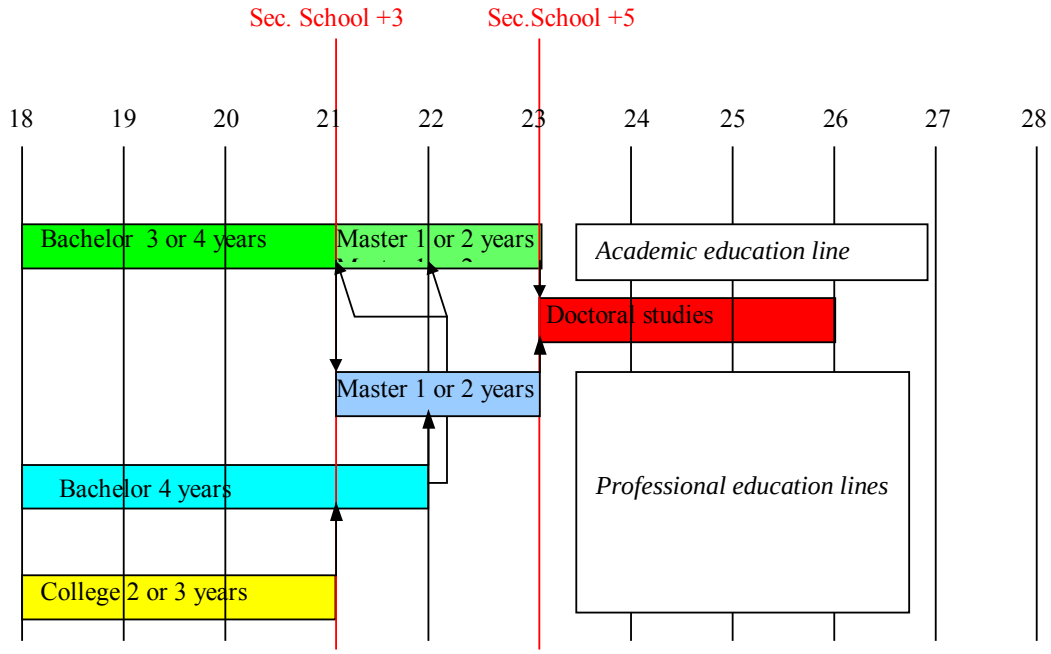

Figure 16.1: Latvian Higher Education System in EIE disciplines

The Law on Education Establishments (1995) sets a difference between academic and professional higher education. In some cases these are merged in one programme issuing academic degrees and professional qualifications at the graduation.
The duration of Bachelor programmes may be 3 or 4 years at different institutions. The 4-year *Bakalaurs*[15] (bachelor) degree is seen as a complete academic qualification, while a 3-year *Bakalaurs* degree is rather an intermediate qualification before choosing between professional programmes or Master studies.
Maģistrs degree is awarded after the second stage of academic education and requires a total duration of university studies of 5-6 years.
According to recent changes in regulations, the Master of Science studies may not be longer than 2 years (previously 3 year programmes were possible) and there must also be 3 year college programmes (previously just 2 years). Besides academic Bachelor and Master degrees since the end of 2001 Professional Bachelor and Master degrees have been introduced. A gradual transformation process to a new system is now on the way.
Curricula of academic study and professional study programmes must contain some stated minimum of studies in Science, General Engineering, Humanities etc. There are also standards for Bachelor programmes in EIE regulating minimum amount of studies in the field of speciality subject areas, e.g. Analogue Electronics, Digital Electronics etc.

[15] *"Bakalaurs"* in Latvian means Bachelor and *"Maģistrs"* in Latvian means Master

16.1.1 Electrical and Information Engineering in Latvia, boundaries of the field of study

Computer Science and Engineering,
Electrical Engineering,

16.1.2 Content, degrees and accreditations

In Latvia new regulation is demanding that study programmes leading to professional qualifications must comply with the standards of profession. These standards in appropriate EIE branch must be developed in co-operation with industry partners and approved by professional organisations, accreditation and licensing.

16.1.3 Implementation of the Bologna-BMD system in Latvia

In the Riga Technical University, largest HE institution providing engineering education in Latvia, 3 year (180 ECTS) Bachelor studies were introduced in the early 90s. It was treated as an intermediate qualification before choosing between professional programmes (1-2 years, 60-120 ECTS) and Master studies (3 years, 180 ECTS). This was a 3-6-9 system. There were also introduced 4 year study programmes leading to Engineer qualifications (without a Bachelor degree), but not allowing continuation in Master studies as a Bachelor is required.
In December 2000 the Law on Higher educational establishments was amended in the spirit of the Bologna declaration. According to these amendments the Law provides for the award of a professional bachelor degree (if the total duration of the programme is no less than 4 years, 160 Latvian credits, 240 ECTS) and a professional master degree (if the total duration of the programme is no less than 5 years (= 200 Latvian credit points or 300 ECTS credits). Thus, in the long run the reforms will lead to a symmetric degree and qualification system shown in the Diagram of Latvia Higher Education System.
From September 1, 2002 Master degree programmes could not be longer than 2 years.
It means mainly 3-5-8, but allowing other schemas too, as 4-6-9, 4-5-8.

16.2. Figures on the weight of EIE in Latvia

University	Faculty	Degree	Number of diplomas in 2001
Riga, Riga Technical University	Faculty of Computer Science and Information Technology	Bachelor of Engineering in Computer Systems and Control	206
		Master of Engineering in Computer Systems and Control	3
		Engineer Qualification in Computer Hardware and Control	19
		Qualification in Information Technologies	46
		Qualification in programming (college) (18)	18
	Faculty of Electronics and Telecommunications	Bachelor of Engineering in Electrical Engineering	96
		Master of Science in Electrical Engineering	24
		Engineer Qualification in Electronics	9
		Engineer Qualification in Telecommunications	38

	Faculty of Electrical and Power Engineering	Bachelor of Engineering in Electrical Engineering	56
		Master of Science in Electrical Engineering	23
		Engineer Qualification in Electrical and Power Engineering	46
	Faculty of Transport and Mechanical Engineering	Bachelor of Engineering in Electrical Engineering	46
		Master of Engineering in Transportation Telematics	23
		Engineer Qualification in Information, Electronics and Control Systems in Transport	48

16.3. Degrees in EIE in Latvia

16.3.1 Bachelor level

Bachelor of Engineering in Computer Systems and Control,
Bachelor of Engineering in Electrical Engineering.

16.3.2 Engineer level

This is a professional qualification (4 years after secondary school, or 2 years after bachelor), which exists in the following fields:

- Electronics
- Computer hardware and control
- Information technology
- Telecommunications
- Programming

16.3.3 Master level

Master of Science in Computer Science,
Master of Science in Electrical Engineering,
Master of Engineering in Computer Systems and Control,
Master of Engineering in Transport Telematics,
Master of Engineering in Electronics.

16.3.4 Doctor level

Doctor of Science,
Doctor of Engineering

16.4. References

The information given in this monograph is based on the following documents and web links:
Ministry of Education and Science http://www.izm.lv/en/default.htm
University and Higher Education Institution Web pages

17. NL: Nederland (Netherlands)

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17.1. General information

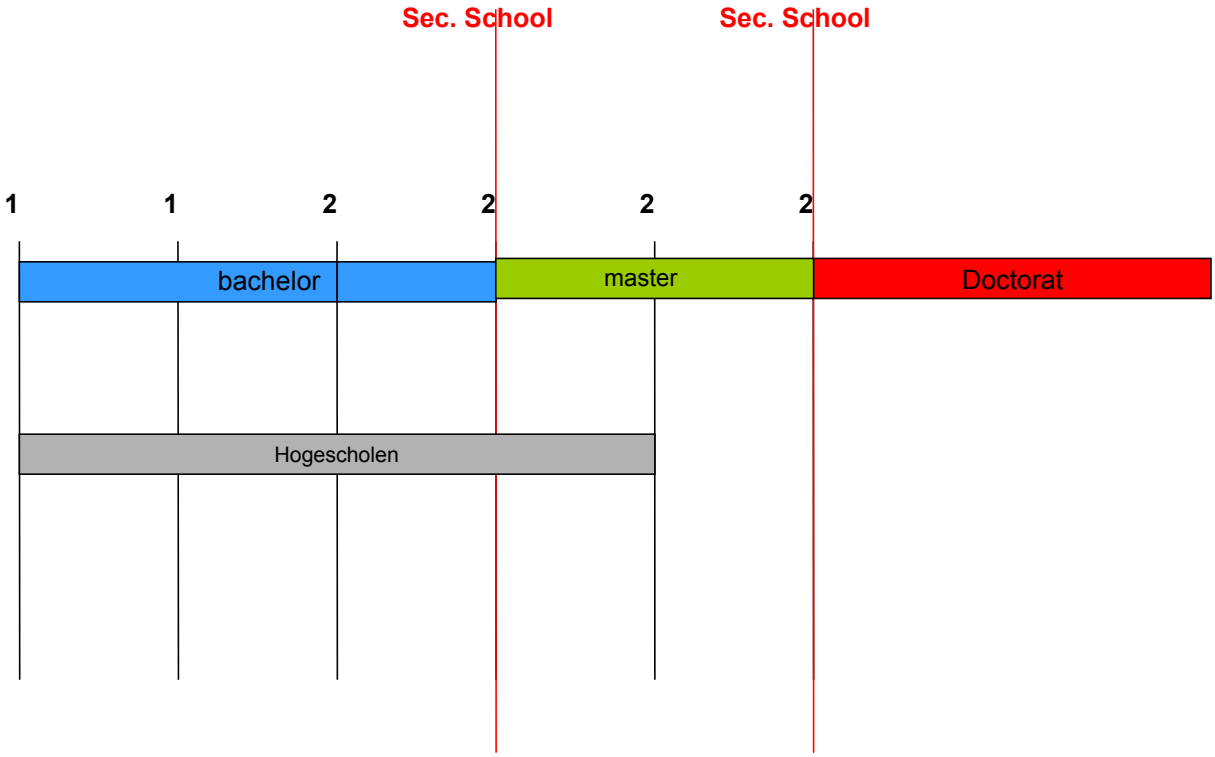

Figure 17.1: Dutch Higher Education System in EIE disciplines

There are three technical Universities (Delft, Eindhoven and Twente), all with EE (Electrical Engineering) curricula. The programs are rather broad in the first years of the study and more related to the research topics in the last two years. In Twente the research of EE concentrates on: microsystems (including micro mechanics, sensors and actuators, micro electronics, optics and magnetic recording), mechatronics (including measurement and control engineering), telecommunication, embedded systems and biomedical engineering. Twente concentrates on information technology and do not have research on electrical power engineering. The other two have.
For further information see:

http://www.el.utwente.nl/index_uk.htm

17.1.1 Implementation of the Bologna-BMD system in the Netherlands

Currently the programma in Twente is converted into the European BSc - MSc structure. The Bsc programma is already in its second year and the MSc programma will fully start in September 2004, although International MSc programmes are already running in English at this moment.

See also: http://www.el.utwente.nl/en/study_programmes/

17.2. Degrees in EIE in Netherlands

Until now the IR (ingenieur) diploma is delivered, after a nominal study of five years. It is equivalent to an MSc degree.

17.2.1 Bachelor level

17.2.1.1 Delft

With the introduction of the bachelor-master programme, all faculties offer one bachelor's course, with the exception of Systems Engineering, Policy Analysis and Management.
The TU Delft has 15 bachelor's courses, taught in Dutch and one in English at the Faculty of Aerospace Engineering.
Each bachelor's course comprises a period of 3 years. From September 2002, the TU Delft has been working with a credit system agreed upon at a European level, the European Credit Transfer System (ECTS). With ECTS, a course year will consist of 60 credits, meaning that a bachelor's course will consist of a total of 180 ECTS. In the interim phase the credit system used formerly will continue to exist with a bachelor's course of 126 credits.
Specific information about each of the Bachelor's courses can be found on the websites of the relevant faculties at the TU Delft. See also the overview of bachelor's courses.

- Aerospace Engineering
- Applied Physics
- Electrical Engineering
- Industrial Design Engineering
- Systems Engineering, Policy Analysis and Management
- Technical Informatics

17.2.1.2 Eindhoven

The Technische Universiteit Eindhoven offers 12 bachelor programmes. Please notice that these programmes are given in Dutch. All the bachelor programmes take three years.
Bachelor Programmes

- Biomedical Engineering
- Electrical Engineering (including Information Engineering)
- Technology and Society
- Industrial Engineering and Management Science
- Computer Science
- Industrial and Applied Mathematics
- Industrial Design

17.2.1.3 Twente

Please note that Dutch is the language of instruction for all Bachelor's programmes.

Computer science : The CS bachelor programme is a 3 year course. This programme is divided into compulsory topics (123 ECTS credits), an elective part (25 ECTS credits), a minor (20 ECTS credits), and an assignment (12 ECTS credits). Currently the course is mainly taught in Dutch.
The lectures of the compulsory part are taken from the following themes: programming and software engineering (20%), computer systems and operating systems (16%), information systems and databases (9%), language, compilers and human computer interaction (12%), telematics (6%), theory and models (7%), mathematics (23%), and context (7%).

Electrical engineering : A 3-year programme taught in Dutch, in the field of Electrical Engineering preparing for further study in a Masters programme. The programme focuses on Information Technology in a wide sense with a course in Microelectronics and Microsystems, Telecommunication and Networks, Control and Measurement techniques, Embedded System Design and Biomedical Engineering.

Telematics: The bachelor programme in Telematics is a 3-year programme. The first year, called the propedeuse, consists of courses that offer an introduction to the area of telematics and a basic knowledge of mathematics and computer science.
The next two years offer a broad overview of the area of telematics and computer science. The courses in telematics cover both functional and fundamental subjects. The functional subjects are networks, services, applications and telecommunication systems. The fundamental subjects are design and implementation, operational management and security of telematics systems. The courses in computer science are devoted to computer architecture, operating systems, databases and software engineering. In the second and third year some advanced courses in mathematics are also offered.
In the third year a minor has to be selected also; a minor is a short programme consisting of courses from another discipline. The bachelor programme is completed with a 3-month final project to be conducted at the university, at a company or at a research institute.
Most courses are in Dutch, but some courses are in English. A year's workload corresponds to 42 SP (study points), which is equivalent to 60 ECTS credits.

17.2.2 Intermediate level, between bachelor and master (Hogeschool)

In "*Hogescholen*", several degrees are available in the fields of computers and informatics as well as in the field of electrical engineering.

17.2.3 Master level

17.2.3.1 Delft

With the introduction of the bachelor-master programme, all faculties offer at least one master's course that links up with the their bachelor's course.
Most of the faculties offer additional master's courses as well. These master's courses are interdisciplinary and/or link up directly with a research focal point of the TU Delft.
Each master's course comprises a period of 2 years. From September 2002, the TU Delft has been working with a credit system agreed on at a European level, the European Credit Transfer System (ECTS). With ECTS, a course year will consist of 60 credits, meaning a master's course will consist of a total of 120 ECTS.
The prerequisites for entering the master's courses have been laid down per course by the Teaching and Examination Regulations (OER). The prerequisites have been derived from the final attainment levels of the preceding bachelor's courses.
Technically, you have to have your bachelor's degree before you can be admitted to the master's courses.

Aerospace Engineering Specialisations: - Simulation and Control - Production Technology	**Applied Mathematics** Specialisations: - Computational Science & Engineering	**Applied Physics**
Computer Science	**Computer Engineering**	**Electrical Engineering** Specialisations: - Microelectronics - Telecommunications - Electrical Power Engineering - Computer Engineering - Media & Knowledge Engineering
Industrial Design Engineering Specialisations: - Product Design - Innovation Management - Industrial Design Engineering	**Mechanical Engineering** Specialisations: - Control engineering and mechatronics - Biomedical engineering	**Media and Knowledge Engineering**
Technical Informatics Specialisations: - Software Technology - Media & Knowledge Engineering - Computer Engineering		

Language
Master's courses with a predominantly international character are given in English. In practice, these are the courses of the English Master of Science International Program for foreign students with a Bachelor of Science degree and students from the Dutch Technical Colleges who have passed with honours. The TU Delft has offered this programme since 1997 and has therefore gained a great deal of experience with teaching in English.

17.2.3.2 Eindhoven

Biomedical Engineering	**Computer Science and Engineering**	**Electrical Engineering and Information Technology**
biomedical imaging & informatics, biosignals & regulation	software technology information systems computational engineering systems engineering	Microelectronics electrical power engineering broad band communication systems architecture of electronic multimedia adaptive systems
Embedded Systems		

17.2.3.3 Twente

Computer Science	Electrical Engineering	Engineering mathematics
Human media interaction	Industrial engineering and management	Mechatronics
Nanotechnology	Telematics	

17.3. References

The information given in this monograph is based on the following documents and web links:
http://www.el.utwente.nl/index_uk.htm, http://www.el.utwente.nl/en/study_programmes/
http://www.tudelft.nl/matrix/info.cfm?PageID=3916&usertype=english

18. NO: Norge/Noreg (Norway)

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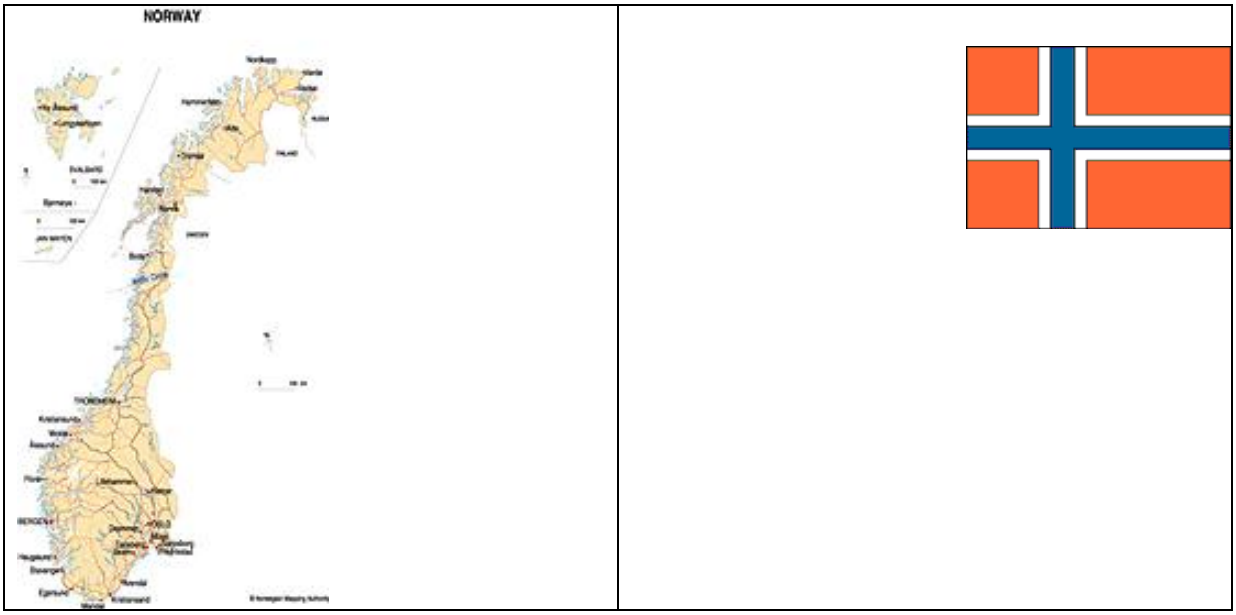
Other contributors: Professor Einar AAS (Norwegian University of Science and Technology (NTNU), einar.aas@fysel.ntnu.no), Professor Kjell MALVIG (Norwegian University of Science and Technology, (NTNU), Kjell.Malvig@itk.ntnu.no)
Lecturer Mr. Gerhard NYGÅRD, Presently working on his PhD at Telemark University College on leave from Bergen University College
Student Janani MYLVAGANAM, Norwegian University of Science and Technology (NTNU)
Review: Cyril BURKLEY (EAEEIE, University of Limerick, Ireland)

18.1. General information

18.1.1 General Information on Norway



Area of Norway is distributed as given below (refer to Map of Norway above): the Kingdom of Norway: 385 155 km^2; mainland: 323 758 km^2 (7.6 per cent protected); Svalbard and Jan Mayen: 61 397 km^2 (57.1 per cent protected).

Norway is situated in the western part of the Scandinavian Peninsula. Length of coastline is 25 148 km, including fjords, from the North Sea along the Norwegian Sea. Its current population is 4 554 000 (as of 1 January 2003). The capital of Norway is Oslo. Norway's second biggest city is Bergen, closely followed by Trondheim.

Norway's natural resources lie in Petroleum, copper, natural gas, pyrites, nickel, iron ore, zinc, lead, fish, timber and hydropower. Norway's agricultural products are pork, milk, beef, veal, wheat, barley, fish and potatoes.

The Norwegian currency is in "kroner", NOK. The Norwegian economy is mainly based on welfare capitalism, featuring a combination of free market activity, government intervention and a plethora planned welfare measures in the social sphere.

The industries in Norway are: petroleum and gas, food processing, ship building, pulp and paper products, metals, chemicals, timber, mining, textiles and fishing. In the field of sensors,

instrumentation and IT based activities, Norway has many leading actors. Many IT based solutions and sensor systems from Norway are integrated into various systems in medical, process and automobile industries world-wide. When it comes to technological achievement, Norway is placed 11th of 68. When it comes to Research and development personnel, Norway has approximately 4,095 per million people, and is placed 5th of 91 in the world ranking. It's investment in research and development is also good, where Norway is placed 18th out of 69.

18.1.2 From secondary school to university education in Norway.

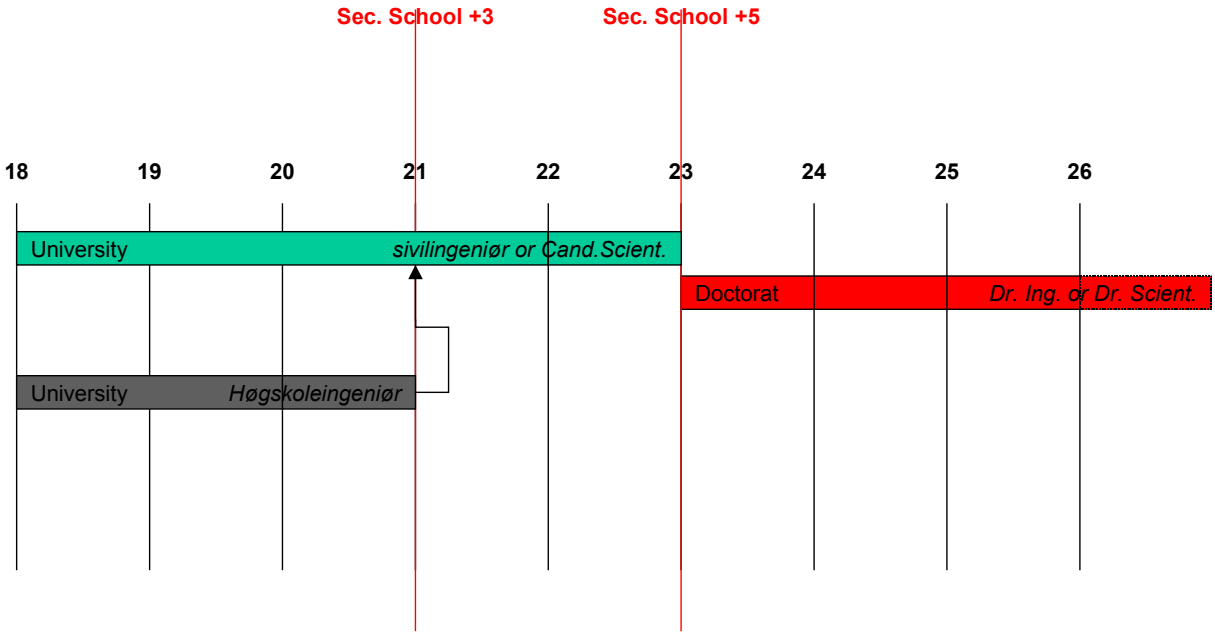


Figure 18.1: Norwegian Higher Education System in EIE disciplines - general trend in the carrier of students. For more details see Figure 18.3.

Some figures:

- 2 years diploma of technician in Norway
- 3 years Bachelor of science
- 30000 students in "External Distance learning programmes"

As of 1994, every child in Norway is offered 12 years of primary and secondary education. The 9 first years are compulsory, while the last 3 years in upper secondary school are voluntary, and end with an examination, which determines entry to higher education, including engineering. Figure 18.1 gives an overview of technical education in Norway, starting from Secondary School.

In Norway, both university and non-university education is offered in engineering. Appendix A contains a list of institutions. The university degree is called "*sivilingeniør*", and is equivalent to a Master of Science/Master of Engineering degree. Nominal time to obtain the degree is 5 years. The major institution awarding this degree has been the Norwegian Institute of Technology (NTH: *Norges Tekniske Høgskole*), a part of the University of Trondheim. (As of 1996, this university has been integrated into the Norwegian University of Science and Technology (NTNU)). NTNU awards approximately 80% of the Masters degrees in engineering in Norway. 34 000 "*sivilingeniører*" have been graduated since 1910. In addition, the degree "*sivilingeniør*" is offered at 5 other universities/regional colleges, but in a limited number of engineering fields. In this report, we have not included the "Cand. Scient." degree, which is technology orientated, but is based upon a traditional university education, whereas

the Master of engineering degrees are given after programmed studies. Although Cand. Scient. degree has been awarded by some universities, the decision made by the authorities to implement BMD system in Norway will lead to a harmonised system of higher degrees in all the fields under discussion in this short note on the higher education in the field of EIE in Norway.

The non-university education in engineering, leading to the degree "*ingeniør*", corresponding to a Bachelor of Science/ Bachelor of Engineering degree, is offered at 15 of 26 state colleges (ref. 1). Nominal time to obtain the degree is 3 years. The regional colleges, 98 in number, were reorganised into these 26 colleges on August 1994. Instead of functional organisation, a regional integration took place through this reform. In Norway, we have an Engineering Education Council for non-university level education, IR (*Ingeniørutdanningsrådet*), which through departmental directives has established a framework for the engineering colleges.

18.1.3 Electrical and Information Engineering in Norway, boundaries of the field of study

This is a difficult question. Elements of EIE are found in many disciplines now. The trend is some stand-alone degrees in Informatics, Electronics, mechatronics, Computer Science etc. But more and more courses are becoming interdisciplinary.

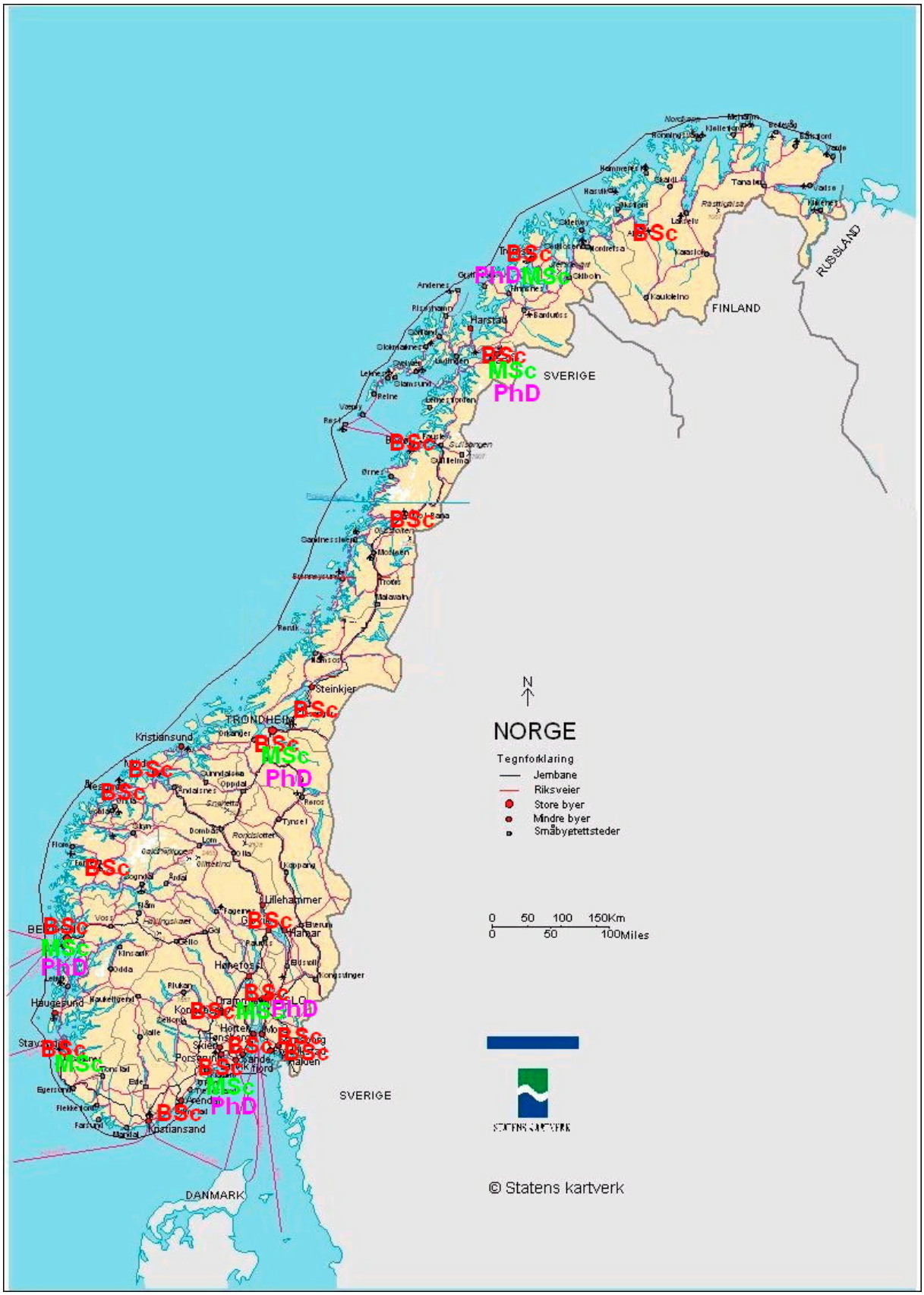


Figure 18.2: The locations of the educating organisations within the field of IT/Computer Science and Electronic/Cybernetics. Figure prepared by Mr. Gerhard Nygård, PhD student at Tellemark University College, presently on leave from Bergen University College.

18.1.4 Content, degrees and accreditations

Due to a new rule (as the results of "*Mjøsutvalget*", committee headed by Prof. Mjøs (medicine)) the colleges and universities have a certain amount of freedom, although the framework is defined by the ministry.
Usually this information is available on the webpage of the colleges / universities.
At NTNU and Telemark University College, particularly in engineering disciplines, course evaluation is used extensively, with student based evaluation of all 1-3 year courses. A system for this evaluation has been developed since 1988. Teacher evaluation has been limited now due to legal problems concerning use of personnel data base information. Programme evaluation, however, is less frequent. Such evaluation is initiated in various fields of higher education from the Institute for Studies in Research and Higher Education, a body of the Norwegian Council of Science. In 1995, an in-depth evaluation of the university and non-university electronic engineering education at 21 universities and technical colleges was completed. The objective of this evaluation was defined thus: Provide qualified assessments of each institution's educational profile, and strong and weak facets in a national and international context. The committee shall not rank the institutions. The assessment shall conclude with a list of actions that may be implemented to improve the education and the learning environment. An important instrument was the self-evaluation phase, resulting in a report read by the experts who conducted the peer review. After assessing the self-evaluation report, the experts visited each institution for two days, and later wrote an evaluation report. These reports are open to the public.

18.1.5 Implementation of the Bologna-BMD system in Norway[16]

Norway is very eager to implement this. It is the policy of the government that latest by 2003, all the universities and colleges should offer Bachelors and Masters and as a result also a PhD within the Bologna-BMD concept. Here follows a short introduction to the Bologna system. Presenting the Engineering education in the Nordic countries for own purposes and for the insight of others is essential. Keep in mind that this is dynamic information, because all the processes in the different countries are not finished yet, and the decisions are not yet final.

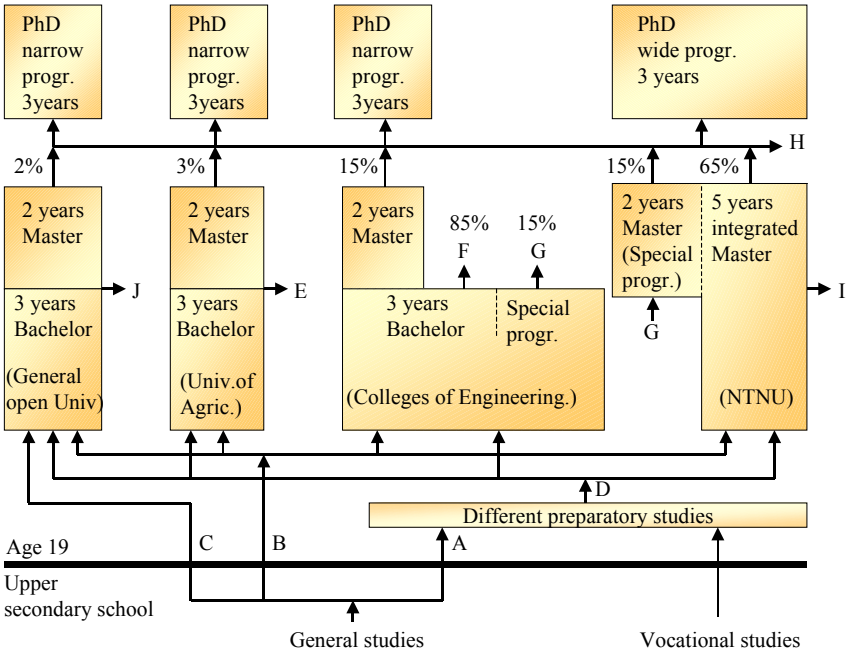


Figure 18.3 Transition from upper secondary school, general studies and vocational studies to universities, university colleges offering BMD. This figure is important to understand what

[16] Based on information provided by Professor Kjell Malvig, Norwegian University of Science and Technology, (NTNU)

follows below on BMD process in Norway. Please refer to the letters A to J in the figure when reading what follows. Provided by Prof. Kjell Malvig of NTNU

1. Entrance from upper secondary school, General studies or Vocational studies

The letters A-J in the following refer to the different stages of transition to higher education as depicted in Figure 18.3.

- B: First level (upper) Mathematics and second level Physics mandatory
- C: Second level Mathematics and first level Physics recommended but not mandatory
- A: For students without required courses

2. Main Structure:

- 3 years Bachelor (E, F, G, J)
- 3 years study pivot (I) (Virtual)
- 2 years Master (H)
- 5 years integrated Master (H)
- 3 years PhD

3. Participating institutions:

One can say NTNU has the highest percentage of "*sivilingeniør*" students.

- NTNU, broad number of programs available on all levels:
  - 5 years integrated Master (65% of total Masters in the nation)
  - 2 years Master based on a Bachelor in the same profession. (Special program for students from other institutions, 15% of Bachelors) (15% of total Masters)
  - 3 years PhD, often with an extra year as Assist. Prof. (98% of total)

- University Colleges of Engineering:
  -3 years Bachelor, professional, broad number of programs.
  -3 years Bachelor, professional, special programmes for continuation as Masters on NTNU, broad number of programmes.
  -2 years Master based on a Bachelor in the same profession. Narrow number of programs.
  -3 years PhD, often with an extra year as Assist. Prof. (2% of total). Narrow special number of programs

- Colleges of Engineering:
  -3 years Bachelor, professional, broad number of programs.
  -3 years Bachelor, professional, special programmes for continuation as Masters on NTNU, broad number of programmes.

- General Universities and Univ. of Agric:
  -3 years Bachelor, probably nonprofessional as engineers, very narrow number of programs. Very few candidates. Questionable in the future.
  -2 years Master based on a Bachelor in the same topic. Very narrow number of programs. Very few candidates. Questionable in the future.
  -3 years PhD, often with an extra year as Assist. Prof. Almost none candidates. Very narrow number of programs

4. Academic titles:

- E,F,G,J:
  -Norwegian: *Bachelor i Ingeniørfag*, name of curriculum
  -English: Bachelor of Engineering, name of curriculum
- H:
  -Norwegian: *Master i Teknologi*, name of curriculum
  English: Master of Science, name of curriculum

5. Professional titles:
   - E, F, G, J:
     -Norwegian: *Ingeniør*, name of curriculum
     -English: Bachelor of Engineering, name of curriculum
   - H:
     -Norwegian: *Sivilingeniør*, name of curriculum
     English: Master of Science, name of curriculum

The following doctoral programmes are offered at NTNU and other universities and the university colleges in the disciplines under focus in our study:

- Dr.Ing. (Engineering)
- Dr.Scient. (Natural Sciences)

The NTNU (according to the information available on its WebPages) gives the following information on doctoral programmes:

"Doctoral degree programmes at NTNU take three years of full-time studies, and are considered to be equivalent to a PhD degree in other countries. The structure of the different doctoral programmes varies. Some of the programmes, like the Dr.Ing. programme, consists of one year of taught courses and a two years research period, where the candidates have to write and defend a dissertation in public."

Figure 18.4: Figures on the weight of EIE in Norway (compiled by Mr. Gerhard Nygård and Ms. Janani Mylvaganam from information provided by the different organisations on their web-pages)

Organisation, (Norwegian Name) (Homepage) (Total number of students in all disciplines)	IT/Computer Science (number of students completing the studies)	Electronics/Cybernetics (number of students completing the studies)
Finnmark UniversityCollege (*Høgskolen i Finnmark*) (2000)	BSc(39)	
University of Tromsø (*Universitetet i Tromsø*) (6000)	MSc(13),PhD(2)	MSc(6),PhD(1)
Tromsø University College (*Høgskolen i Tromsø*) (2500)	BSc(21)	BSc(10)
Narvik University College (*Høgskolen i Narvik*) (1000)	BSc(41),MSc(13),PhD	BSc(11),MSc(10),PhD
Bodø University College (*Høgskolen i Bodø*) (4700)	BSc(10)	
Nesna University College (*Høgskolen i Nesna*) (1300)	BSc(15)	
North-Trøndelag University College (*Høgskolen i Nord-Trondelag*) (4200)	BSc(22)	BSc(13)
Norwegian University of Science and Technology (*Norges Teknisk og Naturvitenskapelige Universitet*) (20 000)	MSc(163),PhD(6)	MSc(148),PhD(13)
South-Trøndelag University College (*Høgskolen i Sør-Trondelag*) (6000)	BSc(69)	BSc(99)
Ålesund University College (*Høgskolen i Ålesund*) (1200)	BSc(21)	BSc(12)
Molde University College (*Høgskolen i Molde*) (1500)	BSc(80)	
Sogn og Fjordane University College (*Høgskolen i Sogn og Fjordane*) (2500)	BSc(13)	BSc(4)
Bergen University College (*Høgskolen i Bergen*) (5000)	BSc(71)	BSc(39)
University of Bergen (*Universitetet i Bergen*) (15000)	MSc(22),PhD(4)	MSc(1),PhD(8)
Naval Engineering College		BSc
Stavanger University College (*Høgskolen i Stavanger*) (7000)	BSc(29),MSc(15)	BSc(39),MSc(13)

Norwegian School of Information Technology	BSc	
Agder University College (*Høgskolen i Agder*) (7500)	BSc(78),MSc(38)	BSc(36)
Telemark University College (*Høgskolen i Telemark*) (4000)		BSc(15),MSc(8),PhD
Vestfold University College (*Høgskolen i Vestfold*) (2600)	BSc(33)	BSc(20)
Østfold University College (*Høgskolen i Østfold*) (4000)	BSc(43),MSc(2)	BSc(19)
Oslo University College (*Høgskolen i Oslo*) (9000)	BSc(96)	BSc(52)
University of Oslo (*Universitetet i Oslo*) (30000)	MSc(76),PhD(8)	MSc(22),PhD(9)
Gjøvik University College (*Høgskolen i Gjøvik*) (1600)	BSc(46)	BSc(14)
Buskerud University College (*Høgskolen i Buskerud*) (2100)	BSc(39)	BSc(12)

18.2. Degrees in EIE in Norway

The courses can be found in the web - pages of the universities and university colleges.

18.2.1 Bachelor (*ingeniør*) level

Currently, there are around 9000 students in the Bachelor of science/engineering programmes. 3600 admissions have been offered each year, but all have not been taken. Thus there are a lot of entries that are not filled, especially at the smaller colleges in Norway. The teaching staff amounts to 900 in total.

- Conditions for admission
  Basically the same conditions for admission apply as for a university, namely completed upper level secondary school, with sufficient course load in mathematics and physics and/or chemistry. Some schools have limited admission, while others allow everyone with a suitable examination grade to enter, because they still do not fill up the predefined capacity.

- Conditions for admission
  The nominal duration is set to 3 years. There is a large variation in real duration from college to college. Some colleges have close to 40% dropout, while others have only 10%.

- Structure of the "*ingeniør*" programmes
  The basic structure for the three-year "*ingeniør*" study program is shown below. The different study programmes are listed in Appendix B.

Basic courses **15 credits**

- Mathematics and statistics 8 credits
- Physics 2 credits
- Chemistry and the environment 3 credits
- Computer engineering 2 credits

Societal issues **5 - 6 credits**

Technical courses **30 credits**

- Study programme courses 10 credits
- Study direction courses 20 credits

Electives **4 - 6 credits**

Diploma thesis **4 - 6 credits**

Sum **60 credits**

The "*ingeniør*" (B. Sc.) diploma is recognised, but it is a trend for companies to prefer M. Sc.-level graduates. Thus, unemployment among B. Sc.-level graduates is about twice as high as that for "*sivilingeniører*". There is also much more competition to enter NTNU than for being admitted to a college offering a B. Sc. education.

18.2.2 Master (*sivilingeniør*) level

The "*sivilingeniør*" (M. Sc.) degree is recognised by the professional environment, and provides access to all kinds of engineering professions in Norway. It is also recognised as the entry-point for a doctoral degree, notably the "*doctor ingeniør*", corresponding to PhD. 70% of NTNU graduates are working in the industry, and 35% belong to top level management. After 10 years, you will find 50% of the "*sivilingeniører*" in leading positions.

- Conditions for admission
  The basic condition for admission is successful examination results from upper level secondary school, with sufficient course load in mathematics and physics and/or chemistry. But as all M.Sc. programmes have limited numbers of places, the examination marks are used to select those admitted. The marks in mathematics and physics are given highest weight. In addition, some points are granted for work experience and completion of military service. Also, female students are given a small additional advantage. The admission to most engineering subjects at the Norwegian Institute of Technology is very competitive.
  In addition to direct entry from upper secondary school, the Norwegian Institute of Technology allows a certain percentage (approx. 20-25%) into the third year with a completed B. Sc. degree from one of the colleges of engineering.

- Nominal and real duration of the studies
  The nominal duration of M. Sc. studies is 4.5 years. The real duration at the Norwegian Institute of Technology is 4.7 years, and the completion rate has been stable at about 91% (defined as the percentage of students, once entered, who finish with a diploma).

18.2.3 Doctorate level

In principle we have two doctorate degrees in engineering in Norway, the doctor techn., and the "*doktor ingeniør*", i.e. doctor engineer. The former is of less and less importance, and very few such degrees are awarded. The "*doktor ingeniør*" degree is now the major doctorate, and is considered to be an education for researchers. It was the ambition of NTH (now part of NTNU) to have 10% of its "*sivilingeniører*" entering a *doktor ingeniør* programme after having finished the M.Sc.

- The *Doktor Ingeniør* (Dr. Ing.) degree

This degree is only offered at the NTNU, Telemark University College, Stavanger University College and Narvik University College. Presently, the university colleges offering Dr.ing. degrees very often collaborate with NTNU. Stavanger University College is expected to achieve university status in the near future.

Condition for admission
A completed "*sivilingeniør*" degree or similar education is required, in addition to a course and research plan endorsed by a supervisor.
Prerequired or simultaneous doctoral programme
The programme includes a certain workload based on courses and a thesis. Normally, the candidate works on both these at the same time. The course load corresponds to one full year of study, while two years are allocated for the research and thesis work. At least one third of the courses are to be at doctorate level, the others may be selected from the normal graduate courses.
Nominal and real duration
Nominal duration is 3 years. Recently, there has been a change to three years of study plus one year of service work for the host department (teaching, grading, supervision etc.), thus allowing for 4 years of calendar time. The average real duration is 3.8 years.
Number of students

More than 100 dr. ing. degrees are awarded every year. There has been an increase from 90 to 129 in 1994.

Main types of financing

Most scholarships are granted directly from the university. Other sources are: the Norwegian Research Council, the Norwegian Telecom, several large companies, and EU programmes.

Professional recognition

The dr. ing. degree is considered to be on an international Ph.D. level, and external opponents, always at least one from abroad, assure that this is the case. Several large Norwegian companies have made it their policy to hire a certain percentage of doctorates, and NTH's (now NTNUs) dr. ing. has a high standing.

18.3. References

The information given in this monograph are based on the following documents and weblinks:

http://www.studmag.no/lenker/article.jhtml?articleID=19593&fraAvis=ap
http://www.nationmaster.com/country/no/Economy
http://populations.com/country.asp?ID=126
http://www.studmag.no/lenker/article.jhtml?articleID=19816&fraAvis=ap
A classic paper on the evolving new educational system in Norway by Prof. Einar Aas, "ENGINEERING EDUCATION IN NORWAY", A report prepared for the European Commission to the Conference of European Schools for Advanced Engineering Education and Research - CESAER, 1995.
http://universitet.no/n.nsf/alt/54CDHM
http://www.euroeducation.net/prof/norco.htm
http://www.nsd.uib.no/english/
http://www.utdanning.no
http://odin.dep.no/odin/engelsk/norway/index-b-n-a.html

19. PL: Polska (Poland)

Coordinating author: Wojciech GREGA (AGH University of Science and Technology, Akademia Górniczo-Hutnicza im. Stanislawa Staszica, wgr@ia.agh.edu.pl)
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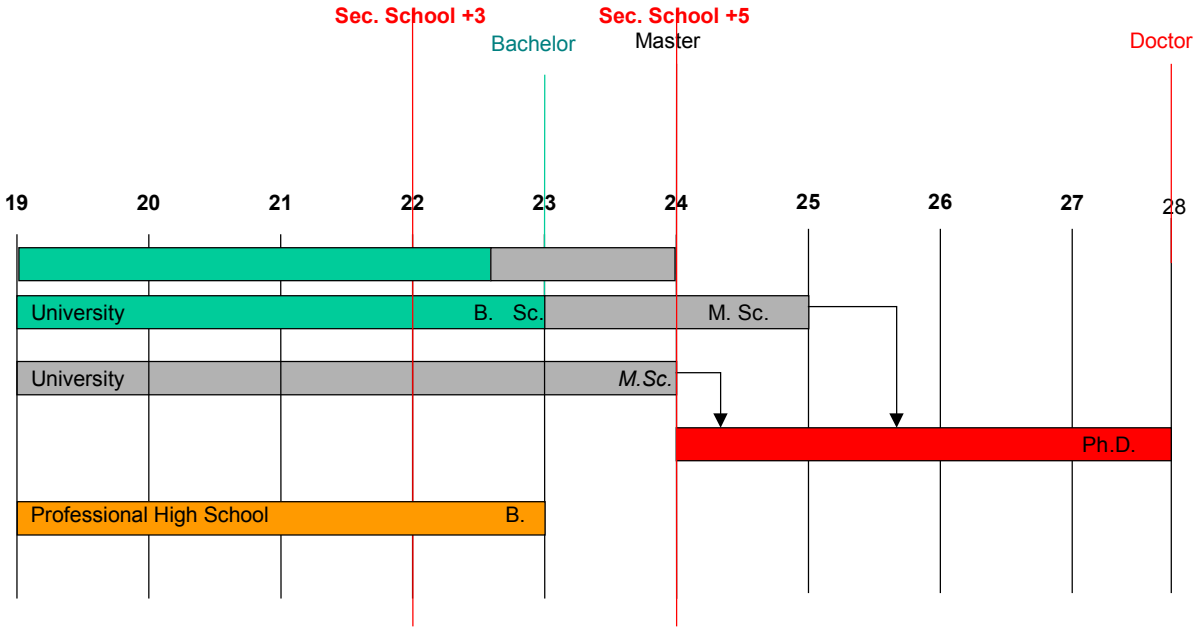
Review: Romanas KRIVICKAS (EAEEIE, Kauno technologijos universitetas, Kaunas, Lietuva (Lithuania))

19.1. General information



At some Polish Universities study for B. Sc . takes 3,5 years and for Ph.D. 3 years

Figure 19.1: Polish Higher Education System in EIE disciplines

In the mid-1990s, 6.8% of Poles had higher education; 2.6% were graduates from post-secondary schools; 50.5% had secondary education (general, technical or vocational); 33.7% had primary education; and 6.3% had either incomplete primary education or none.

The Polish higher technical education system consists of two kinds of institutions:

- **Universities and Technical Universities**, offering scientific oriented education at B Sc., M. Sc. and Ph.D. levels,
- **Professional High Schools**, offering job-oriented education at B.Sc. level.

Beside state-owned institutions there is a growing number of **commercial high schools** offering professional technical education at B. Sc. and M. Sc. levels.

University entry is based on results of "*Matura*" examination or competitive examination. "*Matura*" examination is organized by General Secondary Schools and Technical Secondary Schools. Competitive entry examinations are organized by universities.
The most usual entry criteria are: written or oral entrance examinations based on tests of knowledge; secondary-school-leaving certificates; and qualifying interviews.

Professional High Schools entry is based on results of "*Matura*" examination only. In 2002 the modified system of "New Matura" examination was introduced. It is planned that "New Matura" results will be the only university entry criteria by 2005.

POLISH HIGHER EDUCATION SYSTEM

Population (thousands): 38, 6 mln

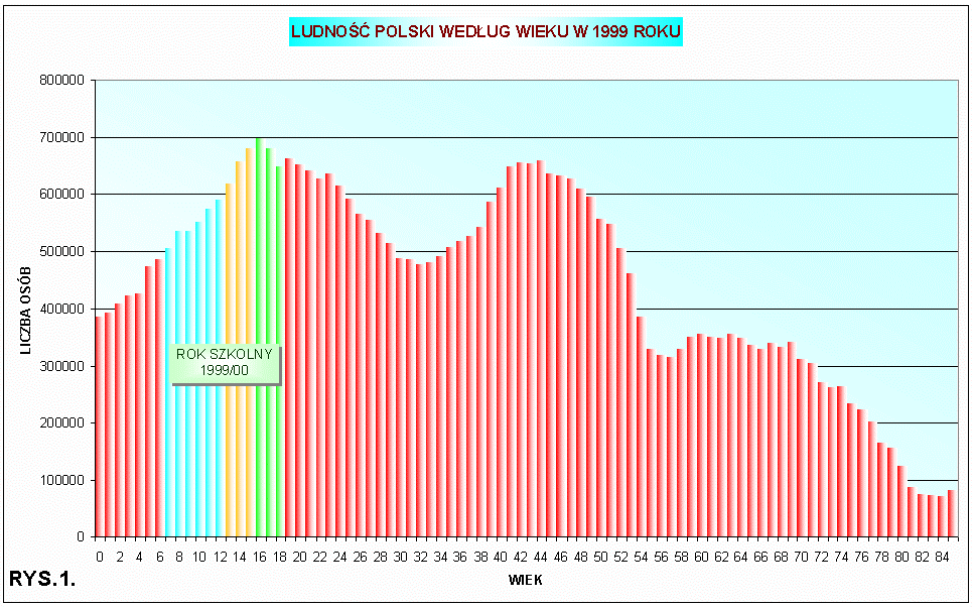


Fig 19.2 Polish population according to the age in 1999 (source: http://www.men.waw.pl/)

The University faculties organize and oversee the educational process within the various study programmes. The institutes and departments are responsible for carrying out study programmes. However, these programmes are not always compatible.

Students study according to a plan of study and curriculum determined by the authorities of the given institution, or they may follow an individual curriculum. They may also follow courses other than their basic fields of study. A credit point system of studies is widely implemented. The language of instruction is Polish; however, at several universities students may often attend lectures given in English, German, or French.

The basic form of higher education in Poland is full-time studies. Institutions of higher education also implement part-time, (evening, extramural) which are equivalent to full-time courses, have similar requirements, and lead to the same degrees and diplomas. During the last few years, these forms of study have become more common as they provide an opportunity to upgrade the qualifications of people who are employed. These forms of study are not free of charge.

The following professional titles/degrees are awarded to graduates of Polish higher education institutions:

At the Bachelor level:

- the professional title of ***licencjat*** is awarded following the completion of 3 or 3.5-year higher professional education courses;

- the professional title of ***inżynier,*** BSc, is awarded following the completion of 3.5 or 4-year higher professional education courses in technical areas but also in agriculture, and economics and related areas;

At the Master level:

- the title of ***magister*** is awarded following the completion of uniform 5 or 6-year magister-level courses in a given field of study; equivalent titles include ***magister inżynier, MSc*** (in the field of Engineering), ***magister inżynier architekt*** (in the field of Architecture) etc,

The title of *magister* may also be obtained following the completion of 2 or 2.5-year complementary *magister*-level courses, for which holders of the professional title of *licencjat* or *inżynier* are eligible.

Upon completion of Master of Science programme (10 semesters) the student receives the Master of Science degree in a given speciality. The Bachelor of Science programmes, depending on speciality chosen, take 6 to 7 semesters and the student receives the title of Engineer.

The academic degree of ***doktor*** is awarded to a person who has passed doctoral examinations and submitted and defended a doctoral dissertation. Holding the professional title of magister or its equivalent is a necessary condition for the doktor's degree;

Currently there are the following numbers of state-owned institutions in Poland:
- Universities: 16,
- Technical Universities: 18,
- Universities of Economics: 5,
- Professional High Schools: 25.

The full list of the institutions is available at: http://www.men.waw.pl/. The list given in the appendix A includes only government-owned institutions in the field of EIE.

19.1.1 Electrical and Information Engineering in Poland, boundaries of the field of study

EIE in Poland means a curricula leading to the following degrees:
- electrical engineering,
- automatics and robotics,
- computer science,
- applied computer science ,
- electronics and telecommunication,
- computer science and econometrics.

The Polish Accreditation Committee (PAC) decides on the establishment or recognition of higher education institutions and establishment or abolition of degrees.
The degrees in *electrical engineering, automatics and robotics, computer science, electronics and telecommunication* and *applied computer science,* generally, are offered at Technical Universities. The degree in *computer science* is offered at several Polish Universities. The degree in *computer science and econometrics* is offered at Universities of Economics.
There are several degrees partly related to the EIE, based on the applications of information technology in engineering (see appendices A and B).

These curricula cover a large spectrum of topics in electrical engineering and information technologies. **Details of the curricula is defined by the specialisations (Fig.19.3, 19.4)**.

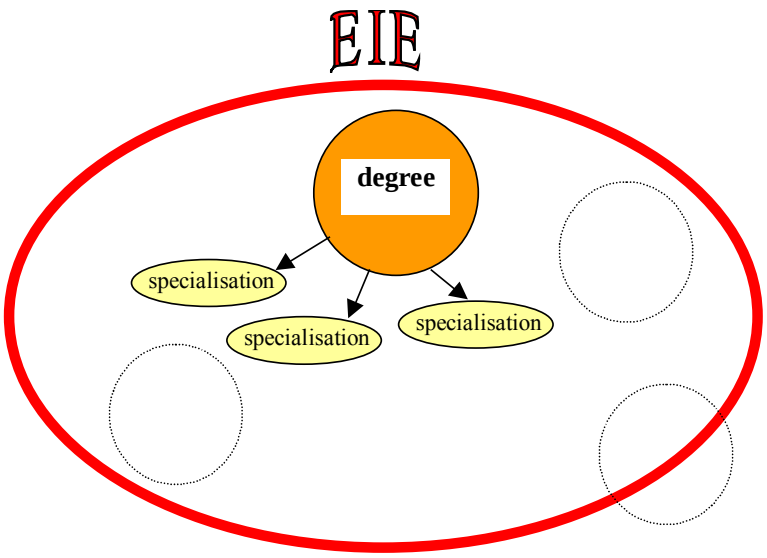


Fig. 19.3 Degrees and specialisations

General comments:

- **EIE** curricula concentrates at the faculties of electrical and computer engineering of **Technical Universities**. Some selected specializations, mainly related to the applied computer science, are implemeted at other faculties and in **Professional High Schools**. For example, the degree in *chemical and process engineering* could be received by studying the EiE specialization *computer application in chemical engineering and technology* at Faculty of Chemical Engineering and Technology of the Cracow University of Technology.

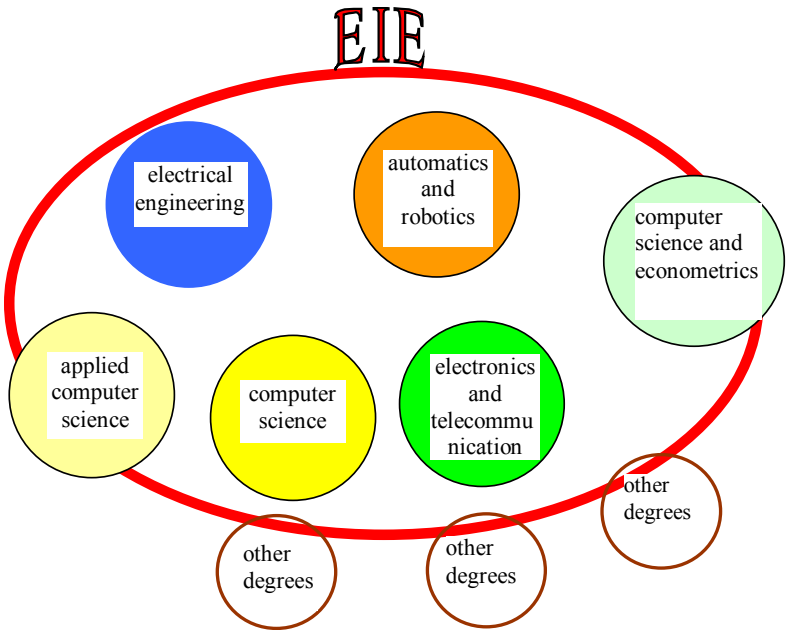


Fig.19.4 Degrees in EIE at technical universities in Poland

19.1.2 Content, degrees and accreditations

General comments:

- The pedagogical content of the diploma strongly depends on selection of the specialisation. The content of the specialisation is proposed by the faculty and decided by the university board. The Polish Accreditation Committee (PAC) supervises the content of the specialisations, in some cases defining the “curricula standards ” to be fulfilled in the frameworks of the specialisation.

19.1.3 Implementation of the Bologna-BMD system in Poland

- There are three systems implemented in parallel:

- three level system : (3,5-4)/(5-6)/(9-10),
- two level system: 5/9,
- one level system: (3-4).

Implementation of the different systems is illustrated in Fig.19.1.

19.2. Figures on the weight of EIE in Poland

In the 2000/2001 academic year 1,584,800 students were enrolled **in 310 higher-education institutions**, with 410,800 of them at 32 universities and technical universities; 28,100 at 10 medical academies; 332,100 at 94 economic schools; 137,500 at 19 teacher's schools; 12,000 at 21 arts schools; and 9,200 at 14 theological schools. (source: http://www.msz.gov.pl/mszpromo/en/1_3.htm)

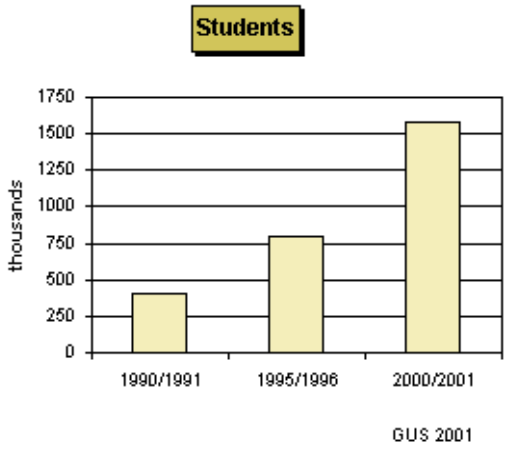


Fig. 19.5 Growing number of students in Poland

Compared with the previous academic year (1999/2000), the total number of students increased by 152,900. There were 115 state and 195 private higher-education institutions. Of the 1,584,800 students, 472,340 were enrolled in private schools.

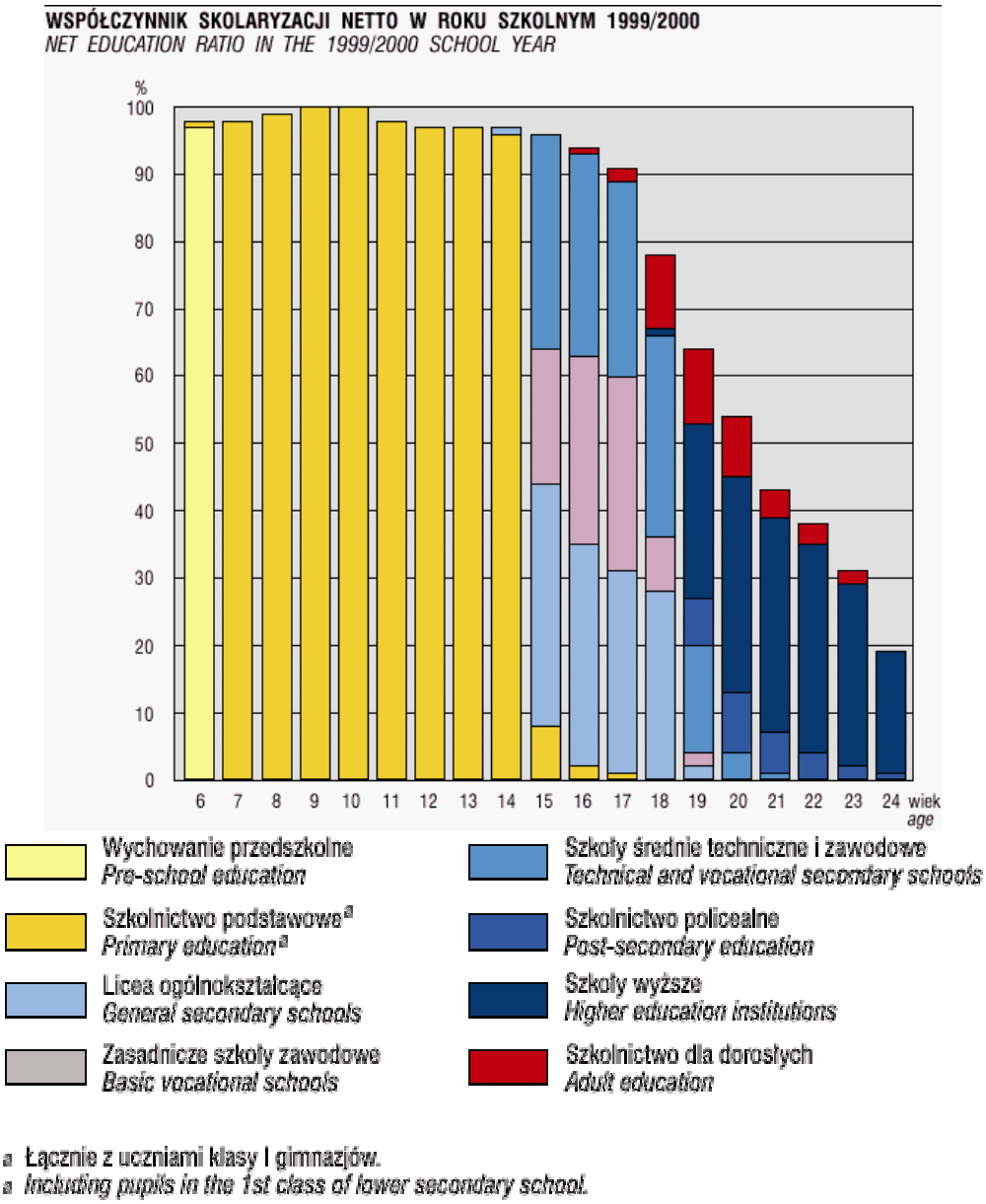


Fig.19.6 Education ratio in Poland in 1999/2000 (source: Small Statistic Yearbook, edited by GUS)

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19.3. Degrees in EIE in Poland

The curricula at B. Sc. and M. Sc. levels are based on the "teaching standards" published by the Polish Ministry of Education and Sport (see: http://www.men.waw.pl, Regulation of 18 April 2002). The teaching standards give the recommended and minimum number of teaching hours required for each degree as well as the pedagogical content of the diplomas. Teaching standards consist of:

- general courses (GC), like Foreign Languages, Economy and Management,
- basic courses (BC), like Mathematics, Physics, Computer Science,
- degree courses (DC), creating the final professional profile of the graduate,
- practical and industrial training (PT).

19.3.1 Bachelor level

B.Sc degrees are offered in:

- electrical engineering
- automatics and robotics, recommended: 2600h, standard: 1200h includes: GC: 300h, BC: 540h, DC: 360h, PT: 6 weeks
- electronics and telecommunication, recommended: 2500h, standard: 1170h includes: GC: 270h, BC: 315h, DC: 585h, PT: 8 weeks
- computer science , recommended: 2500h, standard: 1365h includes: GC: 225, BC: 330h, DC: 810h, PT: not defined
- applied computer science (data not available),
- computer science and econometrics, recommended: 2300h, standard: 1875h includes:, GC: 210h, BC: 390h, DC: 1275h, PT: 6 weeks

Curricula at B. Sc. level is minimum 3,5 years maximum 4 years.

19.3.2 Master level

M.Sc. degrees are offered in:

- electrical engineering, recommended: 3700h, standard: 1995h includes: GC: 360h, BC: 990h, DC: 645h, PT: 12 weeks
- automatics and robotics, recommended: 3800h, standard: 1790h includes: GC: 450h, BC: 800h, DC: 540h, PT: 8-12 weeks
- electronics and telecommunication recommended: 3800h, standard: 1455h includes: GC: 360h, BC: 600h, DC: 495h, PT: 8-12 weeks computer science, recommended: 3600h, standard: 1185h includes: GC: 270h, BC: 345/405*h, DC: 570/630h, PT: not obligatory **(*** - for engineer. degree)
- applied computer science
- computer science and econometrics, recommended: 3200h standard: 1455h include: GC: 270h, BC: 675h, DC: 510h, PT: not obligatory

Education at the M. Sc. level is from 5 to 6 years. Duration of Ph. D studies typically is 4 years.

19.4. References

The information given in this section are based on the following sources:
Small Statistic Yearbook, edited by GUS

Polish Ministry of Education and Sport:
http://www.men.waw.pl/,
http://www.msz.gov.pl/mszpromo/en/1_3.htm
http://elt.britcoun.org.pl/e_poland.jpg

20. PT: Portugal

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Other contributors: Jorge ESTEVES (EAEEIE, Instituto Superior Técnico, Lisboa, jorge.esteves@ist.utl.pt), Maria João MARTINS (EAEEIE, Instituto Superior Técnico, Lisboa, pcjoaom@popsrv.ist.utl.pt)
Review: José Vincente BENLLOCH (EAEEIE, Universidad Politécnica de Valencia, España)

20.1. General information

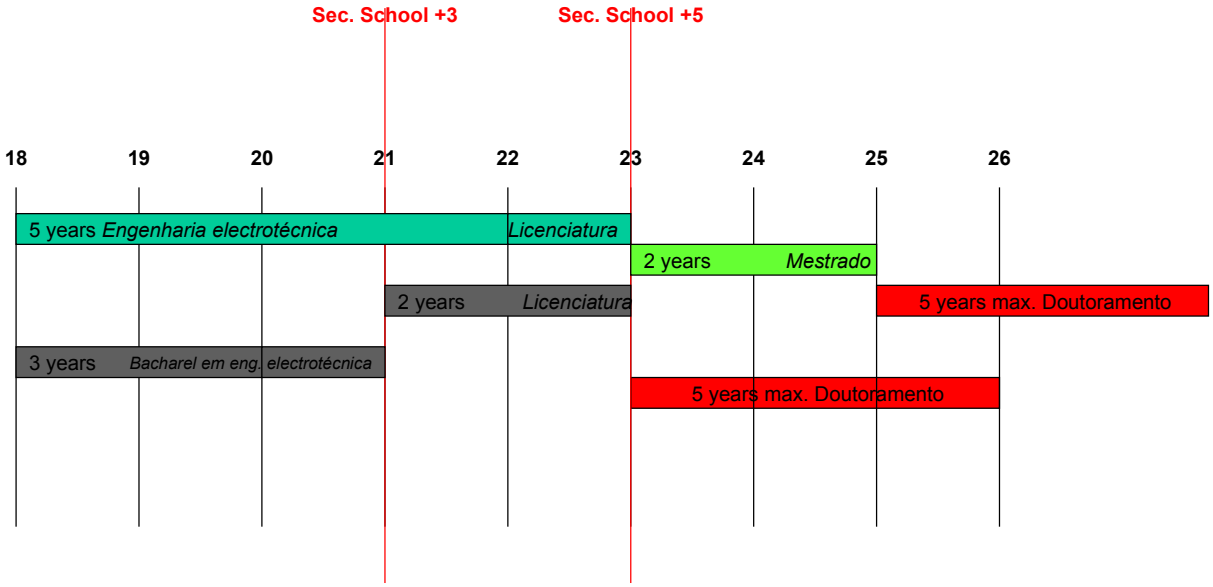


Figure 20.1: Portuguese Higher Education System in EIE disciplines

In Portugal there are classical Universities, Technical Universities and Polytechnic Institutes. The students arrive at the University/Polytechnic after 12 years at the secondary school. As the course/school has "*numerus clausus*", at the end of the secondary school the students have a National Exam to choose the course they want. The students are ordered taking into account the marks obtained in the secondary school, the national exams and the marks obtained in the subjects of mathematics and physics. If they got a place, they can go to a University (Classical or Technical) or to a Polytechnic, taking into account student's preferences and the national ranking.
In Portuguese Universities undergraduate studies last five years leading to the "*Licenciatura*" and continue at a post graduate level for two more years for the degree of *Mestrado*. The "*Licenciatura*" combines a wide education in technological aspects of Electrical Engineering with a deep knowledge in mathematics and physics.
At the Polytechnic, undergraduate studies in Electrical Engineering take three years leading to the *Bacharelato* (1st cycle) and continue for 2 more years (2nd cycle) for the degree of "*Licenciatura*". The first cycle of the course at the Polytechnic has mathematics and physics as well as technological subjects to prepare the students to get a job. At the second cycle at the Polytechnic the students complete their education in mathematics and physics so as their technological subjects. Most of the students that study at the second cycle can get a job, so they work and study simultaneously. After the students have finished the *Licenciatura* they can apply for a *Mestrado* course at a University.

20.1.1 Electrical and Information Engineering in Portugal, boundaries of the field of study

- Electrical Engineering
- Electronics/Microelectronic
- Telecommunications/Communications Technology
- Power Systems
- Automation/Control and Robotics
- Computer Networks
- Computer Science

20.1.2 Content, degrees and accreditations

The curriculum for each course is defined by a scientific committee at each University/Polytechnic.

20.1.3 Implementation of the Bologna-BMD system in Portugal

Presently the Portuguese government is discussing the subject. Probably it will be a 4-5-8. scheme.

20.2. Figures on the weight of EIE in Portugal

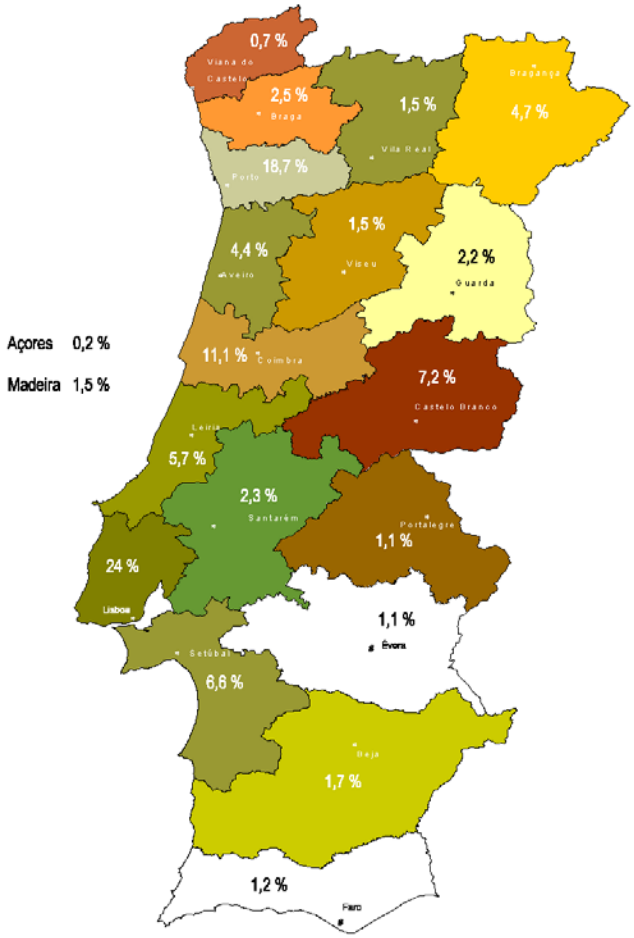


Figure 20.2: Distribution of EIE students in Portugal

The "numerus clausus"[17]for the different courses at the Universities and Polytechnics are presented in the following table:

TABLE 1: NUMERUS CLAUSUS IN VARIOUS PORTUGUESE INSTITUTIONS

CURRICULA	INSTITUTIONS	DEGREE	Numerus Clausus
Engenharia de Computadores e de Sistemas Informáticos	Instituto Politécnico de Coimbra - Escola Superior de Tecnologia e Gestão de Oliveira do Hospital	Bacharelato + Licenciatura	**50**
Engenharia de Computadores e Telemática	Universidade de Aveiro	Licenciatura	**50**
Engenharia de Comunicações	Universidade do Minho	Licenciatura	**30**
Engenharia Eléctrica e Electrónica	Universidade do Algarve - Escola Superior de Tecnologia de Faro	Bacharelato + Licenciatura	**50**
Engenharia Electromecânica	Universidade da Beira Interior	Licenciatura	**30**

[17] The "numerus clausus" is the number of students that each school/course receives each year for the 1st year. This number is fixed by the government taking into account the capacities of the school (number of professors, number of laboratories, general facilities of the school,…)

Engenharia Electromecânica	Universidade de Aveiro - Escola Superior de Tecnologia e Gestão de Águeda	Bacharelato	**20**
Engenharia Electromecânica	Instituto Politécnico de Coimbra - Escola Superior de Engenharia de Coimbra Instituto Politécnico de Portalegre - Escola Superior de Tecnologia e Gestão de Portalegre Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**30** **45** **30**
Engenharia Electrónica e Computadores	Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**55**
Engenharia de Electrónica e Computadores (regime nocturno)	Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**20**
Engenharia Electrónica Industrial	Universidade do Minho	Licenciatura	**70**
Engenharia Electrónica e Redes de Computadores	Instituto Politécnico de V. do Castelo - Escola Superior de Tecnologia e Gestão de V. do Castelo	Bacharelato + Licenciatura	**30**
Engenharia Electrónica e de Telecomunicações	Instituto Militar dos Pupilos do Exército-Secção de Ens. Superior	Bacharelato	**-**
Engenharia Electrónica e de Telecomunicações	Universidade de Aveiro	Licenciatura	**90**
Engenharia Electrotécnica	Instituto Militar dos Pupilos do Exército-Secção de Ens. Superior	Bacharelato	**-**
Engenharia Electrotécnica	Universidade de Aveiro - Escola Superior de Tecnologia e Gestão de Águeda	Bacharelato	**20**
Engenharia Electrotécnica	Universidade da Beira Interior Universidade de Trás-os-Monstes e Alta Douro	Licenciatura	**35** **60**
Engenharia Electrotécnica	Instituto Politécnico de Bragança - Escola Superior de Tecnologia e Gestão de Bragança Instituto Politécnico de Coimbra - Escola Superior de Engenharia de Coimbra Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal Instituto Politécnico de Tomar - Escola Superior de Tecnologia de Tomar Instituto Politécnico de Viseu - Escola Superior de Tecnologia de Viseu	Bacharelato + Licenciatura	**70** **60** **60** **55** **45** **60**
Engenharia Electrotécnica (regime misto)	Instituto Politécnico de Coimbra - Escola Superior de Engenharia de Coimbra	Bacharelato + Licenciatura	**30**
Engenharia Electrotécnica (regime nocturno)	Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**30** **20**
Engenharia Electrotécnica - Automação Industrial e Sistemas de Potência	Instituto Politécnico de Lisboa - Escola Superior de Engenharia de Lisboa	Bacharelato + Licenciatura	**140**
Engenharia Electrotécnica e de Computadores	Universidade de Coimbra - Faculdade de Ciências e Tecnologia Universidade Nova de Lisboa - Faculdade de Ciências e Tecnologia Universidade do Porto - Faculdade de Engenharia Universidade Técnica de Lisboa - Instituto Superior Técnico	Licenciatura	**110** **120** **200** **250**
Engenharia Electrotécnica - Electrónica e Computadores	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**90**
Engenharia Electrotécnica - Electrónica e Computadores (reg. Nocturno)	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**35**
Engenharia Electrotécnica - Sistemas Eléctricos de Energia	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**60**

Engenharia Electrotécnica - Sistemas Eléctricos de Energia (reg. Nocturno)	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**15**
Engenharia Electrotécnica e das Telecomunicações	Instituto Politécnico de Castelo Branco - Escola Superior de Tecnologia de Castelo Branco	Bacharelato + Licenciatura	**50**
Engenharia Informática	Universidade da Beira Interior Universidade de Coimbra - Faculdade de Ciências e Tecnologia Universidade de Évora Universidade da Madeira Universidade Nova de Lisboa - Faculdade de Ciências e Tecnologia	Licenciatura	**60** **80** **45** **50** **170**
Engenharia Informática	Instituto Politécnico de Beja - Escola Superior de Tecnologia e Gestão de Beja Instituto Politécnico de Bragança - Escola Superior de Tecnologia e Gestão de Bragança Instituto Politécnico de Castelo Branco - Escola Superior de Tecnologia de Castelo Branco Instituto Politécnico da Guarda - Escola Superior de Tecnologia e Gestão da Guarda Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria Instituto Politécnico do Porto - Escola Superior de Tecnologia e Gestão de Felgueiras Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal Instituto Politécnico de Tomar - Escola Superior de Tecnologia de Tomar	Bacharelato + Licenciatura	**45** **120** **60** **90** **60** **80** **120** **55** **50**
Engenharia Informática (regime nocturno)	Instituto Politécnico de Beja - Escola Superior de Tecnologia e Gestão de Beja Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**25** **30** **45** **30**
Engenharia Informática e Computação	Universidade do Porto - Faculdade de Engenharia	Licenciatura	**90**
Engenharia Informática e de Computadores	Universidade Técnica de Lisboa - Instituto Superior Técnico	Licenciatura	**170**
Engenharia Informática e de Computadores	Instituto Politécnico de Lisboa - Escola Superior de Engenharia de Lisboa	Bacharelato + Licenciatura	**120**
Engenharia Informática e de Computadores (preparatórios)	Universidade dos Açores - Ponta Delgada	Preparatórios de Licenciatura	**10**
Engenharia Informática e Comunicações	Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria	Bacharelato + Licenciatura	**50**
Engenharia Informática e de Sistemas	Instituto Politécnico de Coimbra - Instituto Superior de Engenharia	Bacharelato + Licenciatura	**60**
Engenharia Informática e de Sistemas (regime misto)	Instituto Politécnico de Coimbra - Instituto Superior de Engenharia	Bacharelato + Licenciatura	**30**
Engenharia Informática e das Tecnologias de Informação	Instituto Politécnico de Castelo Branco - Escola Superior de Tecnologia de Castelo Branco	Bacharelato + Licenciatura	**55**
Engenharia Informática e Telecomunicações	Instituto Politécnico de Viseu - Escola Superior de Tecnologia e Gestão de Lamego	Bacharelato + Licenciatura	**45**
Engenharia de Instrumentação e Electrónica, ramo de Astronomia	Universidade da Madeira	Licenciatura	**10**
Engenharia de Instrumentação e Qualidade Industrial	Instituto Politécnico do Porto - Instituto Superior de Engenharia do Porto	Bacharelato + Licenciatura	**20**

TABLE 2: NUMBER OF ALUMNOS IN SOME PORTUGUESE INSTITUTIONS

CITY	CURRICULUM	SCHOOL	DEGREE	Students 2001/2002	
Açores	Engenharia Informática e de Computadores (preparatórios)	Universidade dos Açores - Ponta Delgada	Preparatórios de Licenciatura		10
Águeda	Engenharia Electromecânica	Universidade de Aveiro - Escola Superior de Tecnologia e Gestão de Águeda	Bacharelato		40
	Engenharia Electrotécnica	Universidade de Aveiro - Escola Superior de Tecnologia e Gestão de Águeda	Bacharelato	**42**	
Aveiro	Engenharia de Computadores e Telemática	Universidade de Aveiro	Licenciatura		140
Braga	Engenharia de Comunicações	Universidade do Minho	Licenciatura		100
Bragança	Engenharia Electrotécnica	Instituto Politécnico de Bragança - Escola Superior de Tecnologia e Gestão de Bragança	Bacharelato + Licenciatura	**204**	190
Beja	Engenharia Informática	Instituto Politécnico de Beja - Escola Superior de Tecnologia e Gestão de Beja	Bacharelato + Licenciatura		70
Castelo Branco	Engenharia Electrotécnica e das Telecomunicações	Instituto Politécnico de Castelo Branco - Escola Superior de Tecnologia de Castelo Branco	Bacharelato + Licenciatura		165
Coimbra	Engenharia Informática	Universidade de Coimbra - Faculdade de Ciências e Tecnologia	Licenciatura		450
	Engenharia Electrotécnica e de Computadores	Universidade de Coimbra - Faculdade de Ciências e Tecnologia	Licenciatura	**790**	
	Engenharia Electrotécnica	Instituto Politécnico de Coimbra - Instituto Superior de Engenharia	Bacharelato + Licenciatura	**522**	
	Engenharia Electrotécnica (regime misto)	Instituto Politécnico de Coimbra - Instituto Superior de Engenharia	Bacharelato + Licenciatura	**127**	
Covilhã	Engenharia Informática	Universidade da Beira Interior	Licenciatura		125
	Engenharia Electrotécnica	Universidade da Beira Interior	Licenciatura	**204**	
Évora	Engenharia Informática	Universidade de Évora	Licenciatura		45
Faro	Engenharia Eléctrica e Electrónica	Universidade do Algarve - Escola Superior de Tecnologia de Faro	Bacharelato + Licenciatura		50
Felgueiras	Engenharia Informática	Instituto Politécnico do Porto - Escola Superior de Tecnologia e Gestão de Felgueiras	Bacharelato + Licenciatura		80
Guarda	Engenharia Informática	Instituto Politécnico da Guarda - Escola Superior de Tecnologia e Gestão da Guarda	Bacharelato + Licenciatura		90
Lamego	Engenharia Informática e Telecomunicações	Instituto Politécnico de Viseu - Escola Superior de Tecnologia e Gestão de Lamego	Bacharelato + Licenciatura		45
Leiria	Engenharia Informática	Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria	Bacharelato + Licenciatura		230
	Engenharia Electrotécnica	Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria	Bacharelato + Licenciatura	**403**	
	Engenharia Electrotécnica (regime nocturno)	Instituto Politécnico de Leiria - Escola Superior de Tecnologia e Gestão de Leiria	Bacharelato + Licenciatura	**187**	
Lisboa	Engenharia Electrotécnica Militar	Academia Militar	Licenciatura	**38**	970
	Engenharia Electrotécnica	Instituto Militar dos Pupilos do Exército Secção de Ensino Superior	Bacharelato	**11**	
	Engenharia Electrotécnica - Automação Industrial e Sistemas de Potência	Instituto Politécnico de Lisboa - Escola Superior de Engenharia de Lisboa	Bacharelato + Licenciatura	**1150**	
	Engenharia Electrotécnica e de Computadores	Universidade Nova de Lisboa - Faculdade de Ciências e Tecnologia	Licenciatura	**531**	
	Engenharia Electrotécnica e de Computadores	Universidade Técnica de Lisboa - Instituto Superior Técnico	Licenciatura	**1729**	
Madeira	Engenharia de Instrumentação e Electrónica, ramo de Astronomia	Universidade da Madeira	Licenciatura		60
Portalegre	Engenharia Electromecânica	Instituto Politécnico de Portalegre - Escola Superior de Tecnologia e Gestão de Portalegre	Bacharelato + Licenciatura		45
Porto	Engenharia Electrotécnica - Electrónica e Computadores	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**660**	675
	Engenharia Electrotécnica - Electrónica e Computadores (regime nocturno)	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**224**	
	Engenharia Electrotécnica - Sistemas Eléctricos de Energia	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**476**	
	Engenharia Electrotécnica - Sistemas Eléctricos de Energia (regime nocturno)	Instituto Politécnico do Porto - Escola Superior de Engenharia do Porto	Bacharelato + Licenciatura	**181**	
	Engenharia Electrotécnica e de Computadores	Universidade do Porto - Faculdade de Engenharia	Licenciatura	**1348**	

Setúbal	Engenharia Electromecânica	Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**375**	265
	Engenharia de Electrónica e Computadores (regime nocturno)	Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**58**	
	Engenharia Electrotécnica	Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**375**	
	Engenharia Electrotécnica (regime nocturno)	Instituto Politécnico de Setúbal - Escola Superior de Tecnologia de Setúbal	Bacharelato + Licenciatura	**58**	
Tomar	Engenharia Electrotécnica	Instituto Politécnico de Tomar - Escola Superior de Tecnologia de Tomar	Bacharelato + Licenciatura	**242**	95
V. Castelo	Engenharia Electrónica e Redes de Computadores	Instituto Politécnico de V. do Castelo - Escola Superior de Tecnologia e Gestão de V. do Castelo	Bacharelato + Licenciatura		30
Vila Real	Engenharia Electrotécnica	Universidade de Trás-os-Montes e Alto Douro	Licenciatura	**430**	60
Viseu	Engenharia Electrotécnica	Instituto Politécnico de Viseu - Escola Superior de Tecnologia de Viseu	Bacharelato + Licenciatura	**352**	60

The number of students who have finished a course in the area of EIE, in the last two years is given in the table below:

TABLE 3: NUMBER OF STUDENTS WHO HAVE FINISHED THE COURSE IN EIE, IN 2000 AND 2001

Engenharia Electrotécnica

Diplomados

Ano Lectivo	***Ensino Universitário***			***Ensino Politécnico***		
	Licenciatura	*M.Sc.*	*PhD*	*1º Ciclo*	*2º Ciclo*	*Total*
1999/2000	458	41	29	340	66	406
2000/2001	370	50	31	330	104	434

20.3. Degrees in EIE in Portugal

20.3.1 Before bachelor (technician level)

After nine years at the secondary school the students can opt to go for a technical course with the duration of three years. After these three years the student can get a job or if he prefers he can opt to go to the University or to a Politechnic School. There are some different courses in the EIE area.

20.3.2 Bachelor level (*bacharelato*)

"*Bacharelato*" (Secondary School + 3 years) is a title that is given by the Polytechnics, for a course program of nominally three years.

20.3.3 "Master" level (*licenciatura*)

"*Licenciatura*" (5 years) is a title that is given by the University, for a course program of nominally five years or a title that is given by the Polytechnics, for a course program of nominally two years after a "*Bacharelato*".

"*Engenheiro* (engineer)" is a title awarded by a specific professional board ("*Ordem dos Engenheiros*") that recognizes the "*Licenciatura*" at a national level, as a professional one.

20.3.4 Other levels: mestrado and doutoramento

Mestrado (*licenciatura* + 2 years) is a title that is given by the University, for a course program of nominally two years after a "*Licenciatura*" (a two semester course and a two semester dissertation).
"*Doutoramento* (Ph.d.)" is a title that is given by the University, after the "*licenciatura*" and a post-graduate research program with a minimum duration of three years with a public discussion of a thesis.

20.4. References

The information given in this monography is based on the following document:
http://www.mces.pt/

21. RO: România

Coordinating author: Denis GENON-CATALOT (Université de Valence, France, EAEEIE, Denis.Genon-Catalot@wanadoo.fr)

21.1. General information

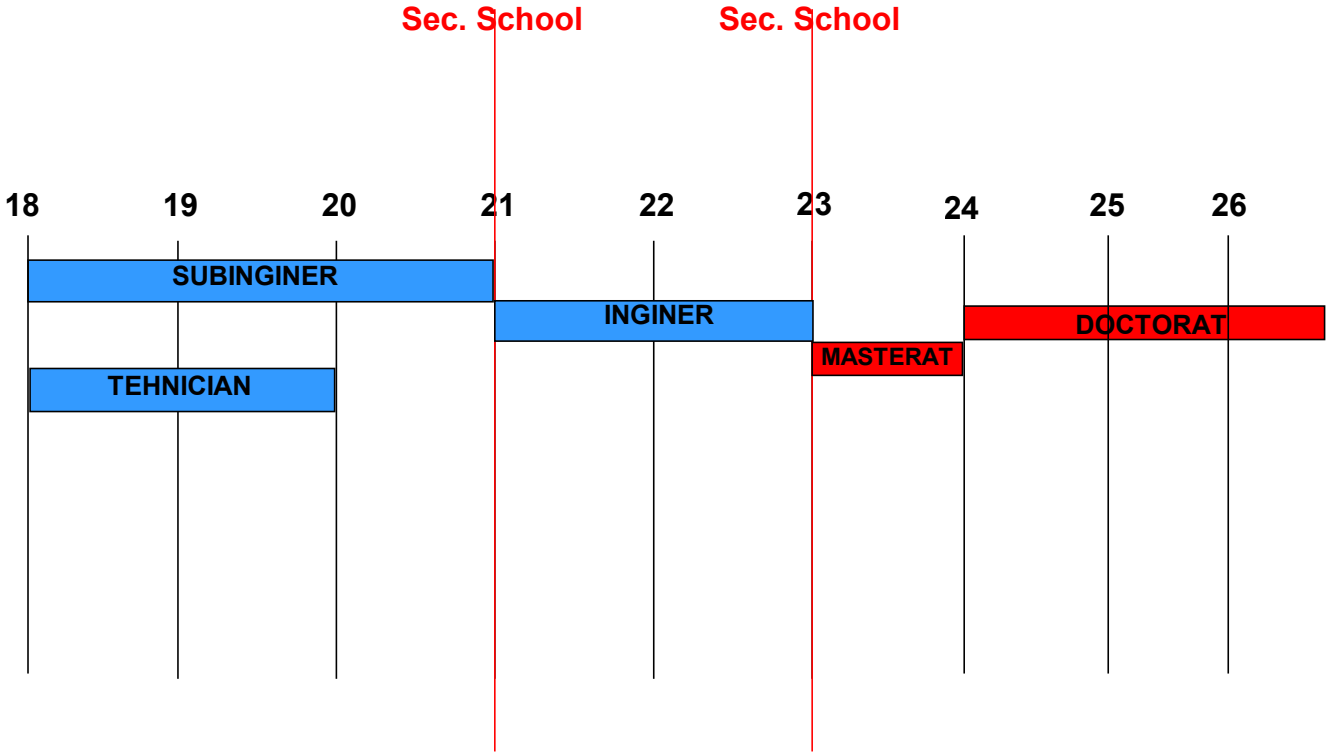


Figure 21.1: Romanian Higher Education System in EIE disciplines

21.1.1 Electrical and Information Engineering in Romania, boundaries of the field of study

In the University "Politehnica" of Bucharest (U.P.B.)[18], there are two faculties that cover the EIE domain:

a. Automatic Control and Computers Faculty
b. Electronic and Telecommunication Faculty

Automatic Control and Computers Faculty with the departments:

· Computer Science and Engineering Department
· The Department of Automatic Control and Systems Engineering
· Control and Industrial Informatics Department

Electronic and Telecommunication Faculty with the departments:

· The Department of Electronics (Computer Science Engineering, Information Engineering, Artificial Intelligence, Image Processing, Industrial Electronics and Medical Electronics)
· The Department of Telecommunication (Microwave and Optical Communications, Mobile and Satellite Communications, Data Transmition Networks, Networks and Network Software for Communication, Multimedia and Hi-Fi Systems)

[18] note : 2 type of courses Item : *Zi initial curricula*
Seral curricula for workers (evening courses)

· The Department of Microelectronics (Microsystems, Microelectronics Engineering, Optoelectronics)

21.2. Degrees in EIE in Romania

- 1st and 2nd year of study represent the common core of the plan of study for the 5 years programme
- after the first two years, the student makes the choice for his direction of speciality

Year of study	Semester	Course Name
1st	1st / 2nd	Mathematical analysis I & II
1st	1st / 2nd	Algebra I & II
1st	1st	Thermodynamics
1st	2nd	Cuantic Physics
1st	1st	Mechanics
1st	1st	Programming Languages
1st	1st	Programming Techniques
1st	2nd	Electrotechnics Bases I
2nd	1st	Special Mathematics
2nd	1st	Electromagnetic Optics
2nd	1st	Electrotechnics Bases II
2nd	1st	Materials
2nd	1st / 2nd	Electronic circuits and systems
2nd	2nd	Digital Electronic Circuits
2nd	2nd	Microprocessors Architecture
2nd	2nd	Signals, Circuits and Systems

21.3. References

http://www.pub.ro -- site of University Politehnica of Bucharest
http://cs.pub.ro/ -- site of Automatic Control and Computers Faculty
http://www.electronica.pub.ro -- site of Electronic and Telecommunication Faculty
http://www.edu.ro/ -- site of Education and Science Ministry in Romania

22. SI: Slovenija (Slovenia)

Coordinating author: Franc NOVAK (Jozef Stefan Institute, Ljubljana, franc.novak@ijs.si)
Review: Jorge ESTEVES (EAEEIE, Instituto Superior Técnico, Lisboa, Portugal)

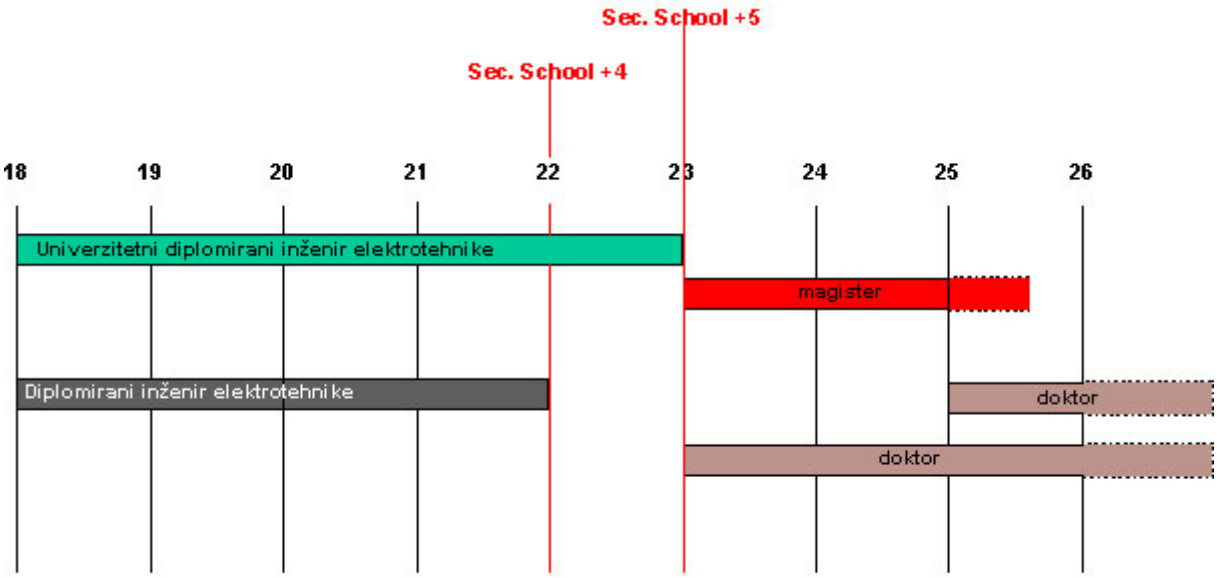


Figure 22.1: Slovenian Higher Education System in EIE disciplines

22.1. General information

There are two universities in Slovenia that cover the general topics in electrical engineering and information technologies:

- University of Ljubljana http://www.uni-lj.si/
- University of Maribor http://www.uni-mb.si/

22.1.1 Electrical and Information Engineering in Slovenia, boundaries of the field of study

EIE subjects are listed in the programmes of the faculties given below.

22.1.2 Content, degrees and accreditation

The curriculum for each course is defined by a scientific committee at each university.

22.1.3 Implementation of the Bologna-BMD system in Slovenia

For official Information on this issue contact: Ministry of Education, Science and Sport, http://www.mszs.si/eng/

22.2. Degrees in EIE in Slovenia

22.2.1 The Faculty of Electrical Engineering (University of Ljubljana)

"Undergraduate" Study Programmes

The Faculty of Electrical Engineering offers two undergraduate educational programmes:

- a five year „university programme" (nine semesters of lectures, 6 months of Diploma thesis work), which leads to the degree „University Dipl. Ing. of Electrical Engineering", and

- a four year programme (six semesters of lectures, 6 months of practice, 3 months of Diploma thesis work), which leads to the degree „Dipl. Ing. of Electrical Engineering".

The entry requirement for the four year programme is completion of a four year secondary education. For the five year „university" programme the national secondary school baccalaureate is mandatory. The four year programme is more application oriented, while the five year programme offers more extensive and in depth theoretical knowledge. Graduates from the five year programme can continue with *"Magister"* or PhD. Study, while graduates from the four year programme can continue with specialisation study.

Both undergraduate programmes have a general core-curriculum which consists of mathematics, physics, fundamentals of electrical engineering and computer engineering. After the first year on the four year programme and after the second year on the five year „university" programme students must choose one of the fields of study:

- Automatic control,
- Electronics,
- Telecommunications,
- Power engineering,
- Quality engineering.

"Postgraduate" Study Programmes

Postgraduate programmes at the Faculty of Electrical Engineering consist of two years (four semesters) of course work. During the *"Magister"* programme, students have to take 1 exam which is compulsory and 4 of them are chosen from 46 possible options in the course. The choice is made with the agreement of both parties: the candidate and the mentor. Before starting writing the thesis, the candidates have to finish their project work. This is followed by a *"Magister"* thesis leading to a *"Magister"* degree and subsequently by a Doctoral thesis leading to a Ph. D. degree in Electrical Engineering. Under special circumstances, students can skip the *"Magister"* thesis and start straight with the work on their Doctoral thesis.

22.2.2 Faculty of computer and information science (University of Ljubljana)

"Undergraduate" programmes

The Faculty of Computer and Information Science offers two undergraduate educational programmes:

- a four year programme (six semesters of lectures, 15 weeks of practice, 6 months of Diploma thesis work), which leads to the degree "Dipl. Ing. of Computer and Information Science", and
- a five year "university programme" (nine semesters of lectures, 6 months of Diploma thesis work), which leads to the degree "University Dipl. Ing. of Computer and Information Science".

The entry requirement for the four year programme is completion of a four year secondary education. For the five year "university" programme the national secondary school baccalaureate is mandatory. The four year programme is more application oriented, while the five year programme offers more extensive and in depth theoretical knowledge. Only graduates of the five year programme can continue their education at the postgraduate level.

Both undergraduate programmes have a general core-curriculum which consists mainly of mathematics and theoretical foundations of computer and information science, and three elective modules in:

- Information Science,
- Computer Logic and Systems,
- Computer Software.

Students must choose one of the three modules after the first year on the four year programme and after the second year on the five year "university" programme.

"Postgraduate" study programmes

Postgraduate programmes at the Faculty of Computer and Information Science consist of two years (four semesters) of course work. This can be followed by a *"Magister"* thesis leading to a *"Magister"* degree and subsequently by a Doctoral thesis leading to a Ph.D. degree in Computer and Information Science. Under special circumstances, the *"Magister"* thesis can be avoided and students can go straight to work on their Doctoral thesis. The faculty offers two postgraduate programmes:

- Computer and Information science,
- Information Systems and Decision Making.

22.2.3 Faculty of electrical engineering and computer science (University of Maribor)

"Undergraduate" studies

The Faculty of Electrical Engineering and Computer Science offers two separate types of study programs, each leading to a different type of degree: university and professional one. Three study programs with several options are offered towards the university degrees and two study programs towards professional degrees.
The university-degree study program in Electrical Engineering includes the following options:

- Automation with concentrations in:
  - Production Automation
  - Process Automation
- Electronics with concentrations in:
  - Computer Electronics
  - Telecommunications Electronics
- Power Engineering with concentrations in:
  - Power Engineering
  - Electromechanical Systems Control
  - Electromagnetics
- Mechatronics with concentrations in:
  - Communications
  - Regulations
  - Instrumentation
  - Actuation
  - Embedded Systems
  - Programmable Tracking Systems

The option of Mechatronics is interdisciplinary, supported by the Faculty of Electrical Engineering and Computer Science and by the Faculty of Mechanical Engineering. Also the computer science students are eligible for this option after the first two years completed in computer science. University-degree studies last nine semesters and include lectures, exercises, and practical placements in industry, with the exception of Mechatronics whose duration is eight semesters. The first two years are the same for all options.

The professional higher education program in Electrical Engineering comprises the following options:

- Automation with concentrations in:
  - Process Automation
  - Robotics
- Electronics with concentrations in:
  - Industrial Electronics
  - Computer Electronics
- Power Engineering with concentrations in:
  - Power Engineering
  - Electromechanical Systems Control
  - Electromechanical Devices Construction
- Telecommunications

Professional higher education programs last six semesters consisting of lectures and exercises, and an additional semester of practical placements in industry. The first year of studies is common for all options.

Electrical engineering is also offered as a combined interdisciplinary university-degree study of electrical engineering with economics. It is organised by the Faculty of Electrical Engineering and Computer Science and by the Faculty of Business and Economics in Maribor. The duration of studies is eight semesters with about 2/3 major subjects given in electrical engineering and 1/3 major subjects in business and economics.

Graduates of electrical engineering with economics are qualified to proceed with their studies towards masters or PhD degrees either in electrical engineering or in business and economics.

The university-degree study program in Electrical Engineering with Economics includes the following options:
• Automation
• Electronics
• Power Engineering

The university-degree study program in Telecommunications consists of two years of study with common fundamental subjects and two additional years with a variety of electives. Therefore, the studies last eight semesters and include lectures, exercises, and practical placements in industry.

The university-degree study program in Computer and Information Science includes the following options:
• Software with concentrations in:
  - Systems
  - Engineering Informatics
• Information Science with concentrations in:
  - Business Information Systems
  - Process Information Systems

University-degree studies last nine semesters and include lectures, exercises, and practical placements in industry. The first two years are the same for all options. After the first two years in computer science studies, students can continue in the mechatronics option within the electrical engineering program.

The professional higher education program in Computer and Information Science comprises the following options:

• Software
• Information science
• Logic and systems

Professional higher education programs last six semesters consisting of lectures and exercises and an additional semester of practical placements in industry. The first year of studies is common for all options.
In academic year 2002/03, a new university studies programme of Media Communications began. The curriculum is covered interdisciplinary and co-ordinated by the Faculty of Electrical Engineering and Computer Science of Maribor. The students in senior years are able to specialise in *RTV Production* and *Interactive Graphic Communication,* while the total duration of studies is eight semesters. The title received after a successful completion with a diploma work will be a Media Communicologist with University Diploma.

"Postgraduate" study programmes

Graduate studies basically aim at the acquisition of in-depth theoretical and applied knowledge enabling the prospective graduate to carry out independent and creative research in various technical sciences.

"Magister" degree and PhD studies

In 2002, *"Magister"* degree and doctoral studies were organised in combination with the undergraduate schemes. It was renewed with additional subjects. All the subjects were also grouped in two subsets: a smaller one contains majors according to different study options, while a bigger group comprises electives. Every student must select at least two majors belonging to his or her study option.

Three graduate programs are currently being offered:
- Electrical Engineering
- Electronic Vacuum Technology
- Computer and Information Science

For every graduate student entering the first year of studies, their supervisor selects the following:

- the courses that the student will attend and the exams the student will complete
- a research project that will be individually assigned to and conducted by the student

The student must collect a minimum of 120 credits during the first two years. Out of this total, 75 credits must be awarded for the examinations, while 45 credits must be awarded for the reports completed on their individual research projects. For every passed exam and publicly presented report on individual research projects, the student is awarded 15 credits.

"Magister" degree studies are research oriented and include introduction to research, the development of students' capacity for research work in individual scientific fields and disciplines, and the study of subjects providing in-depth and broad knowledge of subjects needed for the preparation of a *"Magister"* thesis.

Throughout the program of study, students can use laboratories and the computer infrastructure of the Faculty of Electrical Engineering and Computer Science as well as other engineering faculties at the university. Studies leading to *"Magister"* degrees grant the graduates a professional title of a *"Magister"* in Electrical Engineering or a *"Magister"* in Computer Science.

PhD research is carried out in research laboratories. Research teams consisting of doctoral students and graduate students for individual areas of research are commonly formed. Some research teams include participants from several laboratories. International contacts developed through the teams are especially important for doctoral students, because this is the only way for them to take part in the international transfer of knowledge and exchange research achievements. Some of our doctoral students carry out part of their research abroad and even have co-mentors in other countries.

22.3. References

The information given in this monograph is based on the following documents and weblinks:

- Annual Report, Research activities 2002, Faculty of electrical engineering and computer science, University of Maribor
- Research and development at the Faculty of electrical engineering in Ljubljana, 2002, Faculty of electrical engineering, University of Ljubljana
- information available on the web pages of the faculties

23. SK: Slovensko (Slovak rep.)

Coordinating author: Jozef JASENEK (Slovak University of Technology Bratislava, jozef.jasenek@elf.stuba.sk)
Other contributors: L. Jurisica (FEI, STU Bratislava), J. Turán (FEI, TU Košice), V. Hrabovcová (FEI, University of Zilina)
Review: Michal CHMELA (Brno University of Technology, Ceska Republika)

23.1. General information

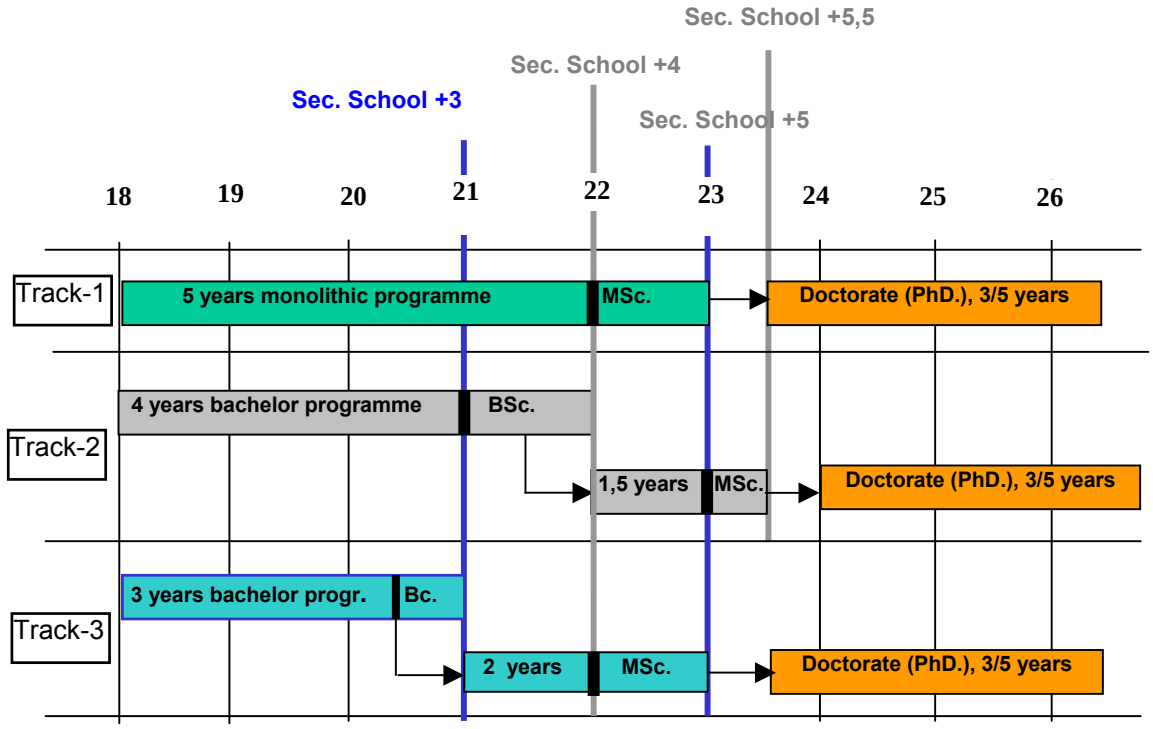


Figure 23.1: Slovakian Higher Education System in EIE disciplines

According to the new HE (Higher Education) law there are public, state and private HE institutions in Slovakia. Universities are mostly public institutions. There are 22 public universities in Slovakia but only 4 of them offer education in EIE. They are - Slovak University of Technology Bratislava (Faculty of Electrical Engineering and Information Technology), University of Žilina (Faculty of Electrical Engineering, Faculty of Management Science and Informatics), Technical University of Košice (Faculty of Electrical Engineering and Information Technology) and the Alexander Dubček University in Trenčín (Faculty of Mechatronics).

All study programs provided by the HE institutions have to be approved by the Scientific Board of the HE institution and accredited by the Accreditation Commission, which is a body established by the government. Accreditation of the programme should guarantee that certain minimum quality criteria of the education provided are obeyed.

The general condition for the admission to the first-degree program is the completion of the secondary grammar school (SS) and a successful completion of the programme entrance examination.

The general condition for the admission to the second-degree program is the successful completion of the first-degree programme in the same specialization or a related one and the successful completion of the programme entrance examination.
The general condition for the admission to the PhD. programme is the successful completion of an appropriate second-degree programme and the completion of the programme entrance examination.

The education in the area of EIE at the level of "technicians" is described in 23.3.1.

23.1.1 Electrical and Information Engineering in Slovakia, boundaries of the field of study

According to the new HE law (No. 131/2002) passed in February 2002, new study programmes, that will be introduced in the academic year 2004/5, will be based on a new "System of study fields in HE" issued by the Ministry of Education of the Slovak Republic in December 2002. Following this document the study programs in EIE at the level of the first degree (Bc.-1), the second degree (MSc.-2) and the third degree (PhD.-3) will be based on the main fields as follows – Electrical engineering (1,2), Electromagnetic theory (3), Electrical power engineering (3), Electrical technologies and materials (3), Electronics (1,2,3), Automation (1,2,3), Telecommunications (1,2,3), Mechatronics (1,2,3), Energetics (1,2,3), Electrical power engineering (3), Nuclear energetics (3), Informatics (1,2,3), Theoretical computer science (3), Theory of teaching in informatics (3), Computer engineering (1,2,3), Software engineering (1,2,3), Information systems (1,2,3), Cybernetics (1,2,3), Artificial intelligence (2,3), Applied informatics (1,2,3), Business informatics (1,2,3).

TABLE: NEW SCHEME

Level of the degree	Electrical engineering	Electromagnetic theory	Electrical power engineering	Electrical technologies and materials	Electronics	Automation	Telecommunications	Mechatronics	Energetics	Nuclear energetics	Informatics	Theoretical computer science	Theory of teaching in informatics	Computer engineering	Software engineering	Information systems	Cybernetics	Artificial intelligence	Applied informatics	Business informatics
Bachelor	X				X	X	X	X	X		X			X	X	X	X		X	X
Master	X				X	X	X	X	X		X			X	X	X	X	X	X	X
PhD		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

23.1.2 Content, degrees and accreditation

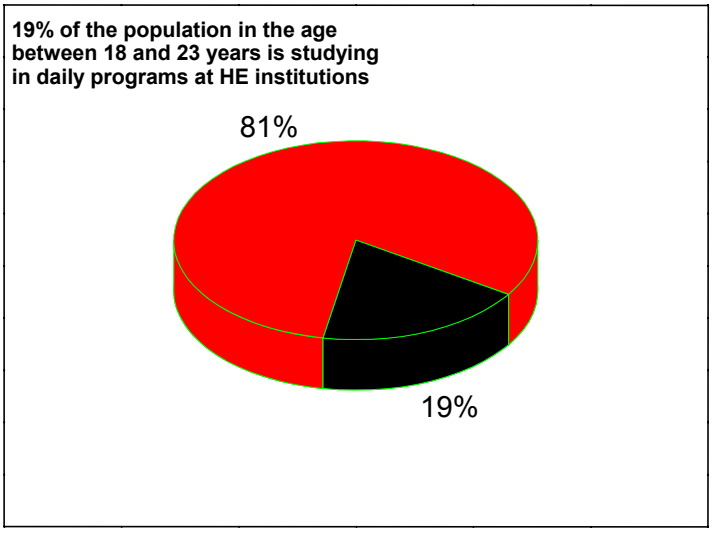
The curricula of all HE study programs are designed by the professors who are employed at the particular HE institution, that will offer the programme, in cooperation with the professionals from the industry at home and from abroad. The process of the curricula design takes into account the internal HE institution quality assurance criteria. The final version of the program has to be approved by the Scientific Board of the HE institution and

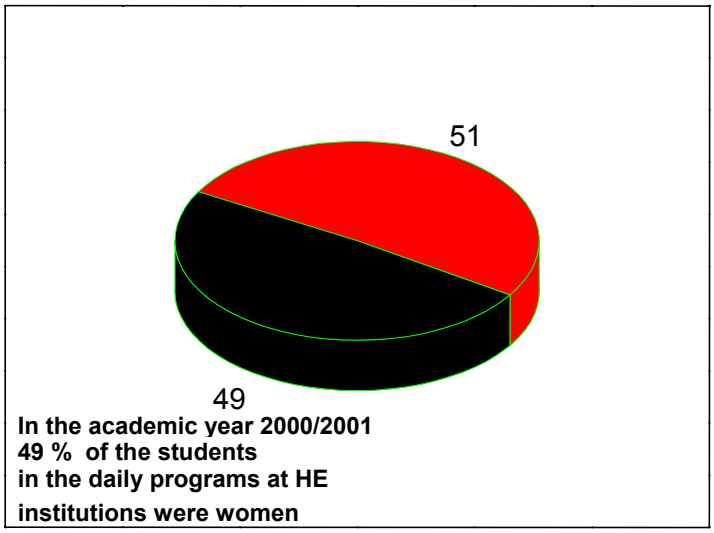
also by the HE institution Academic Senate. After that the program has to be accredited by the Accreditation Commission that is the advisory body of the Slovak Government.

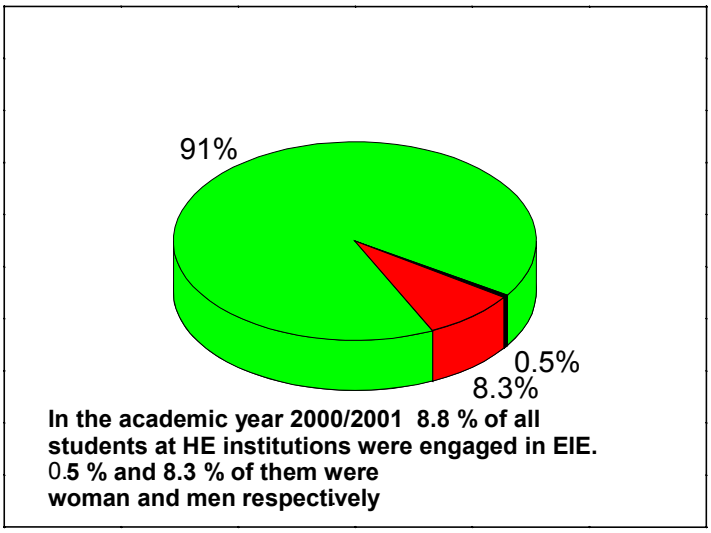
23.1.3 Implementation of the Bologna-BMD system in Slovakia

In February 2002 new HE law was accepted by the Parliament. All substantial features of the Bologna mainframes are built into the new law. It concerns mainly the implantation of the three cycle system of study [Bc., Mgr. or Ing. (equivalent to MSc.) and PhD.], the implementation of the ECTS, the limits of length of the first and second cycle of the HE programs and the doctoral programs (PhD.). Generally one can state that the scheme Bologna-BMD in Slovakia has been legally accepted and is being continually introduced into practical life.

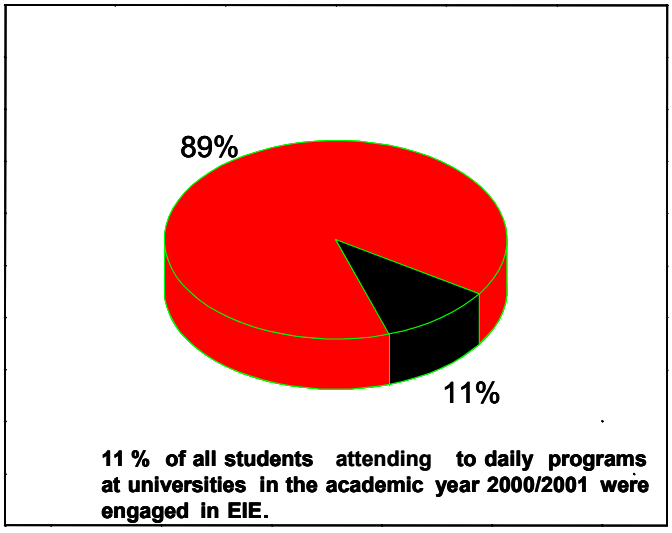
23.2. Figures on the weight of EIE in Slovakia







In the academic year 2000/2001 8.8 % of all students at HE institutions were engaged in EIE. 0.5 % and 8.3 % of them were woman and men respectively



11 % of all students attending to daily programs at universities in the academic year 2000/2001 were engaged in EIE.

Level	Number of students
Bachelor (SS + 4) – First degree program	480
Bachelor (SS + 3) - First degree program	320
Master program (Bc. + 1,5) – Second degree program	380
5 year integrated **master** program (SS + 5) – Second degree program	460

23.3. Degrees in EIE in Slovakia

23.3.1 Technician program

The education in the area of EIE at the level of “technicians” is provided by the special industrially oriented secondary grammar schools (*Stredna priemyselna skola*). The nominal duration of the program at these schools are 4 years. The programme is completed by the “School-leaving examination” (*Maturita*). After the program completion the students look for a job (can be added "as a technician") or can apply for admission to the university program.

There is also another possibility to obtain the technical education at the level of “technician” - the “Vocational Schools” (*Stredne odborne ucilistia* – Apprentice Professional Schools) with the nominal program duration of 3 years. After the program completion one can go for a job or continue in the program for another two years (that is a total of 5 years) and complete the program by the “School-leaving examination” (*Maturita*). These people can then apply for the admission to the university program."

23.3.2 Bachelor (SS + 3) - First degree program

Bachelor in Electroenergetics and Power Engineering
Bachelor in Control Engineering and Automation
Bachelor in Computers and Informatics
Bachelor in Electric Traction and Energetics
Bachelor in Telecommunication Management
Bachelor in Information and control systems

23.3.3 Bachelor (SS + 4) – First degree program:

Bachelor in Automation
Bachelor in Information Technology
Bachelor in Telecommunications
Bachelor in Electronics
Bachelor in Electromaterial Engineering
Bachelor in Power Electrical Engineering

23.3.4 Master program (Bc. + 1,5) – Second degree programme

Ing. in Automation
Ing. in Information Technology
Ing. in Telecommunications
Ing. in Electronics
Ing. in Electromaterial Engineering
Ing. in Power Electrical Engineering

23.3.5 5-year integrated master program (SS + 5) – Second degree program:

Ing. in Electroenergetics and Power Engineering
Ing. in Control Engineering and Automation
Ing. in Computers and Informatics
Ing. in Electric Traction and Energetics Telecommunication
Ing. in Information and control systems
Ing. in Information and Safety Systems
Ing. in Electronics and Telecommunication Systems
Ing. in Technologies in Electronics and Materials
Ing. in Electrical Measurements
Ing. in Industrial Engineering

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The information given in this monograph is based on the following documents and weblinks:

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http://www.utc.sk
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http://www.tnuni.sk
http://www.education.gov.sk

Special publication:
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(„Statistical Annual Report for HE of the Slovak Republic”)
published by the „Institution for the information and prognoses in HE", Bratislava, 2002

24. UA: Україна (Ukraine)

Coordinating author: Andriy ZYNOVCHENKO (EAEEIE, Priazovskyi State Technical University, Mariupol, and Universität Ulm, Deutschland, andriy.zynovchenko@e-technik.uni-ulm.de)
Other contributors: Oleksandr ZYNOVCHENKO (EAEEIE, Priazovskyi State Technical University, Mariupol, aazyn@yahoo.com), Yuriy SAYENKO (Priazovskyi State Technical University, Mariupol)
Review: Jan LIGUŠ (EAEEIE, Technical University of Košice, Slovakia)

24.1. General information

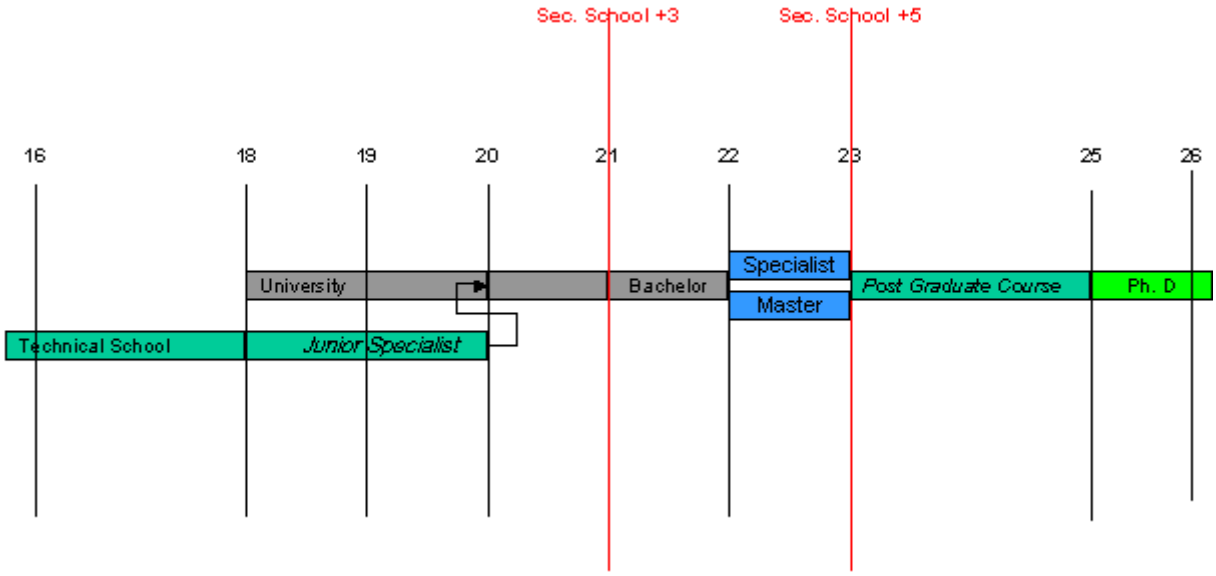

Figure 24.1: Ukrainian Higher Education System in EIE disciplines

The structure of the higher education of Ukraine was built according to the structure of education in the developed countries of the world as determined by UNESCO, UN and other international organizations. The higher education constitutes integral part of the system of education of Ukraine as provided for by the Law of Ukraine "On Education".
Training of specialists in higher educational institutions may be carried out full-time or part-time (evening, correspondence education), by combining these two forms or, for certain professions, without attending classes.
Diplomas in EIE-specialities can be obtained from a Technical School, from an Institute or from a University. The structure of educational institutions of Ukraine is presented below:

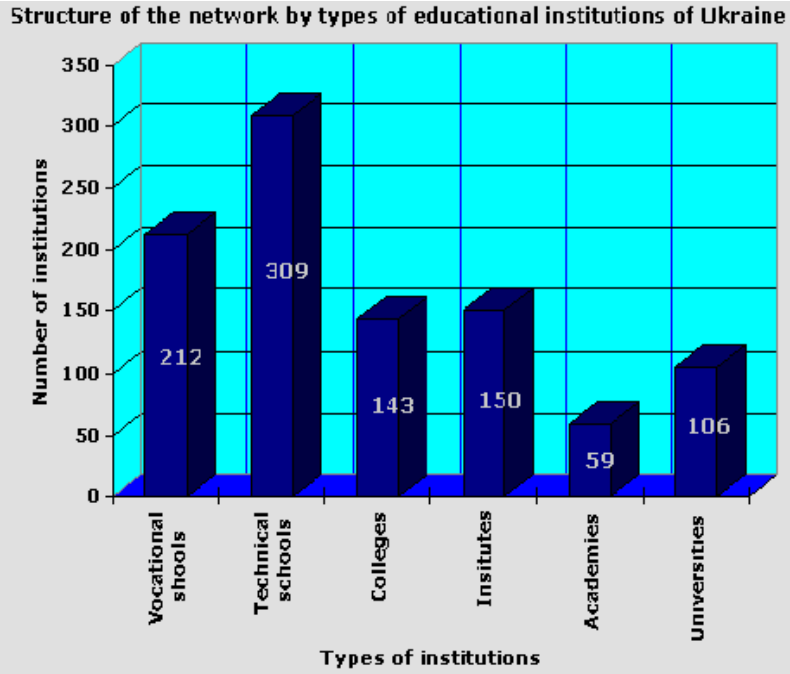

Figure 24.2: The structure of educational institutions of Ukraine

24.1.1 Electrical and Information Engineering in Ukraine, boundaries of the field of study

In Ukraine there are three main disciplinary fields:

- Electrical Engineering (including varieties)
- Informatics (with varieties)
- Automatics and Control in various technical fields

24.1.2 List of general EIE specialities:

- Computer Systems and Networks
- Information Control Systems and Technologies
- Software of Automated Systems
- Computer Science
- Electromechanical systems of Automatiom and Electric Drive
- Electrical Engineering Systems of Power Consumption
- Radioelectronic Devices, Systems and Complexes
- Electronic Systems
- Radio Engineering
- Manufacturing of Radio Electronic Devices
- Radio Communication, Broadcasting and TV Equipment
- Information Technologies
- Microelectronics and Semiconductor Devices
- Dedicated Computer Systems
- Power Stations
- Radiophysics and Electronics
- Electric Machines and Apparatus
- Telecommunicational Systems and Networks
- Electric Systems and Networks
- System Programming
- Technologies and Telecommunication Means
- Electric Machines and Apparatus
- Power Engineering in Agriculture

- Household Electronic Appliances
- Thermoelectric Power Stations
- Flexible Computer Systems and Robotics
- Robotized Systems and Complexes
- Information Communication Networks
- Electronic Home Appliences
- Atomic Power Engineering

24.1.3 Content, degrees and accreditation

The curriculum of diplomas is defined as follows:

- Obligatory part (1/3 of the whole curriculum) is defined by the Ministry of Education and Science of Ukraine.
- 1/3 part of the curriculum is defined by the University Council.
- 1/3 part of the curriculum for the concrete speciality is defined by the department leading this speciality and then approved by the University Council.

24.1.4 Implementation of the Bologna-BMD system in Ukraine

There is a negligible number of students who graduate with the 4-year Bachelor diploma, so it can be considered the system implemented in Ukraine is close to the Bologna-BMD system.

24.2. Figures on the weight of EIE in Ukraine

The structure of the students admission by areas of training is shown.

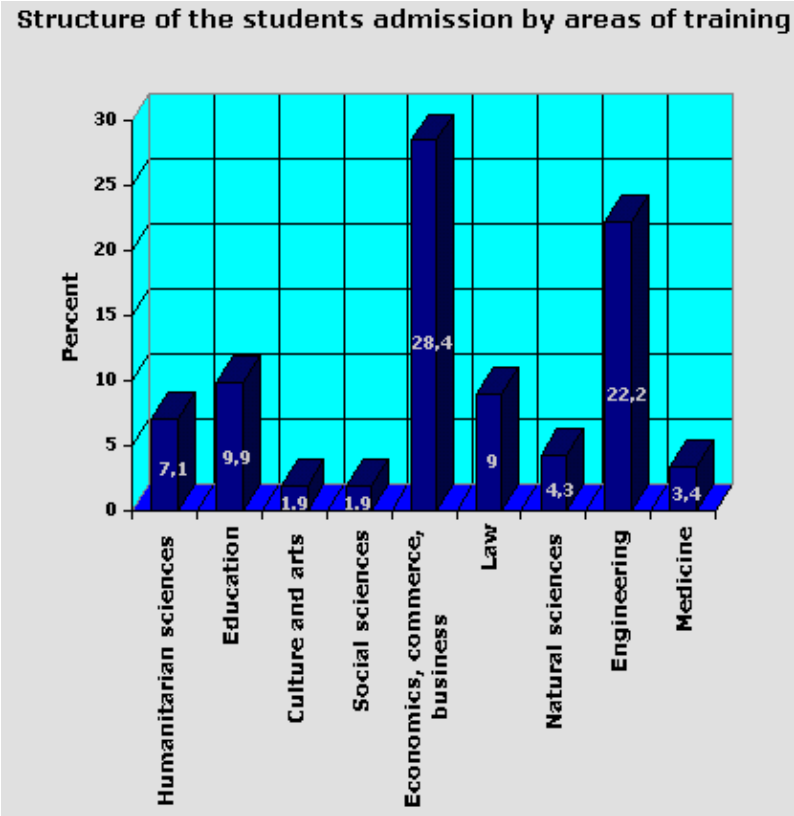

Figure 24.3: The structure of the students admission by areas of training

EIE subjects are also found in the curricula of some specialities other than EIE-specialities.

24.3. Degrees in EIE in Ukraine

- Secondary school + 3 years: Junior Specialist degree in one of the specialities listed in 24.3.2.
- Secondary school + 4 years: Bachelor degree in one of the specialities listed in 24.3.2.
- Secondary school + 5 years: Specialist or Master degree in one of the specialities listed in 24.3.2.

Remarks:

1. The overwhelming majority of students continue their studies after having obtained the Bachelor's degree in order to get the Master's or Specialist's Degree.
2. The exact title of a 5 year degree (Specialist or Master) is different in different institutions. In industry all these degrees have nearly the same value.

In each of the specialties listed below a student can obtain either Junior Specialist or Bachelor, Specialist or Master degree. The Specialist and Master degrees can be awarded only after the Bachelor degree has been earned. Educational institutions giving only Junior Specialist or only Bachelor degree are usually not independent, but they are integrated in one or another high school giving Specialist or Master degree. That is why such educational institutions and high schools can be considered together as a single whole.

All percentages below are given related to a whole degree curriculum taken as 100%.

24.3.1 General elements, social and behavioral skills

Curricula percentages in general elements and social and behavioral skills are equal across all of the listed specialties, but are different for different degrees.

Junior Specialist degree: Foreign language 5%; social sciences 13%; projects 10%; industrial training period 15%.
Bachelor, Specialist, Master degrees: Foreign language 7%; social sciences 13%; projects 15%; industrial training period 12%.

24.3.2 EIE Specialties.

Percentages in EIE-curricula are equal across Junior Specialist, Bachelor, Specialist and Master degrees, but are different for different specialities.

Computer Systems and Networks: Informatics/Computer 28%; Networks 14%; Electronics 7%; Telecommunications 7%;
Information Control Systems and Technologies: Informatics/Computer 18%; Telecommunications 15%; Networks 10%; Electronics 12%;
Software of Automated Systems: Informatics/Computer 18%; Telecommunications 15%; Networks 10%; Electronics 12%;
Computer Science: Informatics/Computer 28%; Networks 14%; Electronics 7%; Telecommunications 7%;
Electromechanical systems of Automation and Electric Drive: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;
Electrical Engineering Systems of Power Consumption: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;
Radio Electronic Devices, Systems and Complexes: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Electronic Systems: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Radio Engineering: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Manufacturing of Radio Electronic Devices: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Radio Communication, Broadcasting and TV Equipment: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Information Technologies: Informatics/Computer 28%; Networks 14%; Electronics 7%; Telecommunications 7%;
Microelectronics and Semiconductor Devices: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Dedicated Computer Systems: Informatics/Computer 28%; Networks 14%; Electronics 7%; Telecommunications 7%;
Power Stations: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;
Radio physics and Electronics: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Electric Machines and Apparatus: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;
Telecommunication Systems and Networks: Informatics/Computer 18%; Telecommunications 15%; Networks 10%; Electronics 12%;
Electric Systems and Networks: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;
System Programming: Informatics/Computer 28%; Networks 14%; Electronics 7%; Telecommunications 7%;
Technologies and Telecommunication Means:
Electric Machines and Apparatus: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;

Power Engineering in Agriculture: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;
Household Electronic Appliances: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Thermoelectric Power Stations: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%;
Flexible Computer Systems and Robotics: Informatics/Computer 11%; Networks 7%; Electronics 12%; Automation 14%; Electrical engineering 12%;
Robotized Systems and Complexes: Informatics/Computer 11%; Networks 7%; Electronics 12%; Automation 14%; Electrical engineering 12%;
Information Communication Networks:
Electronic Home Appliances: Informatics/Computer 12%; Networks 9%; Electronics 22%; Telecommunications 12%;
Atomic Power Engineering: Informatics 7%; Electrical networks 8%; Electronics 9%; Automation 10%; Electrical engineering and electrical equipments 21%.

24.4. References

The information given in this monograph is based on the following documents and weblinks:
Ministry of Education and Science of Ukraine http://www.education.gov.ua

25. UK: United Kingdom

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25.1. General information

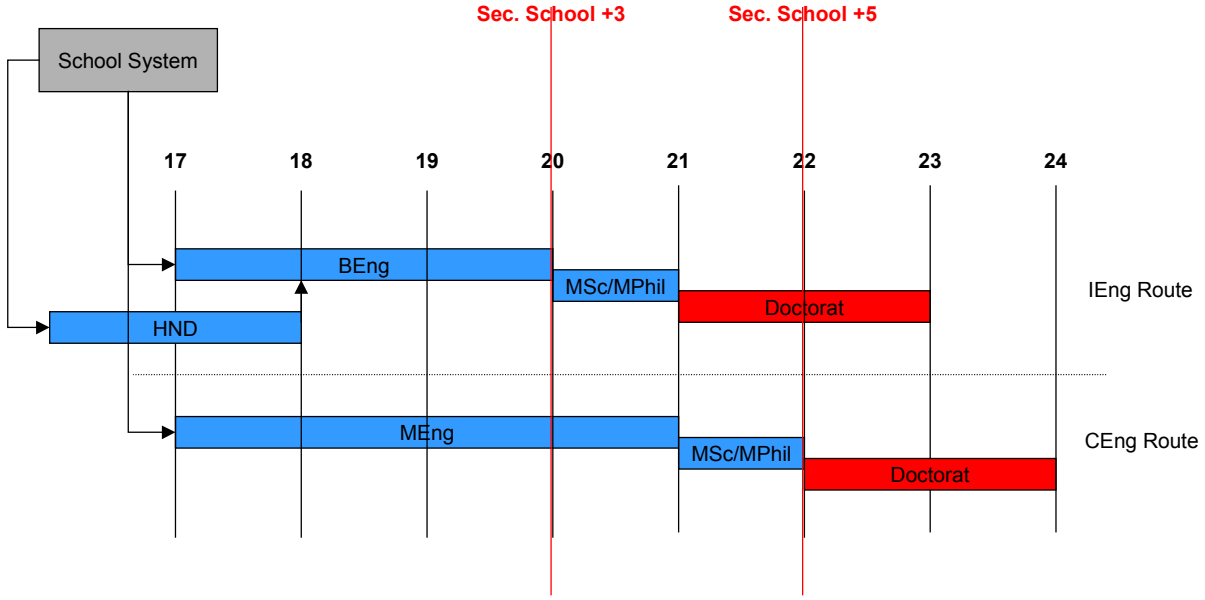

Figure 25.1: UK Higher Education System in EIE disciplines

This description commences with a summary of the conventional Higher Education system in the UK. This is then followed by an overview of some of the variations on the theme that can occur.

Firstly to clarify terminology, in the UK the whole degree is usually referred to as a programme of study rather than a course although in the UCAS (Universities and Colleges Admission System) guide below the term course is used. Programmes comprise a number of modules. In this section the terms programme and module will be used in favour of courses.

Higher Education usually commences with students aged 17 or 18 immediately after A-level education within a school or sixth form college, during which students will usually study 3 subjects. Students enter University, subject to meeting the A-level entry points requirement for their selected programme of study at their preferred academic institution. Students can choose from a range of durations of degree programmes, from the minimum of three years to a current maximum of five years (assuming no agreed period of absence). The three-year variant of the programme will be either a Bachelor of Science (BSc) or Bachelor of Engineering (BEng). Both these programmes can, when agreed by the academic institution, be increased to four years by adding a year in industry to form a 'sandwich' degree.

The four-year variant of the undergraduate programme will typically be a Master of Engineering (MEng). This programme can also be increased to five years by adding a year in industry to form a 'sandwich' degree. The Bachelor of Science, Bachelor of Engineering and Master of Engineering are all undergraduate or First Cycle programmes (FCD).

FCDs are typically graded using pass, ordinary, third class, lower second class, upper second class and first class classifications, although not all academic institutions use all of them. Some institutions use a Pass/Fail classification for MEng programmes.

Upon completion of an undergraduate programme any student can undertake a postgraduate Masters programme, the duration of which is usually one-year full time. Masters degrees can

be either taught or by research. Also, upon completion of an undergraduate programme and subject to the student achieving an upper second or first class honours, a student can undertake a three-year Doctoral programme. Both the Master and Doctorate programmes are Second Cycle Degrees (SCD).
A wide range of variations is possible. Students can defer entry to higher education after school/college in favour of employment, returning to the academic system at any stage. In a similar way, a break can be taken between the FCD and the SCD. Both the FCD and SCD can be taken part time, although part time FCDs are less common. The Open University also offers the facility to undertake modules of study and build up a FCD over a larger number of years.

25.1.1 Electrical and Information Engineering in United Kingdom, boundaries of the field of study

One of the definitions possible for EIE lies in the way in which a student would select a course within an academic institution. The source for this information is the Universities & Colleges Admission System (UCAS) http://www.ucas.ac.uk. UCAS adopts a hierarchical approach to classifying first cycle degrees. A search of related key words to EIE reveals the following hierarchy and hence list of courses that lie within the EIE general area. In the following list the numbers in brackets refer to the number of courses under that name that are offered within the UK.

Electronic/Electrical (851 courses) & Electronic/Electrical Engineering (1255 courses)

- Aeronautical electronics (3 courses)
- Applied electronic (5 courses)
- Automotive electronic engineering (2 courses)
- Digital electronics (6 courses)
- Electronic / electrical engineering (1255 courses)
- Electronic business (3 courses)
- Electronic communications (2 courses)
- Electronic communications systems (5 courses)
- Electronic computer systems (2 courses)
- Electronic control (64 courses)
- Electronic design (3 courses)
- Electronic graphics (2 courses)
- Electronic imaging (4 courses)
- Electronic media (9 courses)
- Electronic media design (2 courses)
- Electronic music (57 courses)
- Electronic power engineering (3 courses)
- Electronic systems (11 courses)
- Electronic systems design (3 courses)
- Electronic systems engineering (6 courses)
- Mechanical electronic systems engineering (1 course)
- Medical electronics (13 courses)
- Power electronic (2 courses)
- Power electronic systems (1 course)

Computer Science (3111)

- Business systems engineering (9 courses)
- Computing (2826 courses)
- European computer science (2 courses)
- Information (1724 courses)
- Information systems (519 courses)
- Information technology (581 courses)
- Information Engineering (7 courses)
- Information Science (67 courses)

- Information systems engineering (10 courses)
- Infomration technology systems (2 courses)

Computer Systems Engineering (402)
Telecommunications (103)

Notes :
The above list is a reduced list to include only those subjects considered to be directly of interest to the EAEEIE.
There are no courses currently titled Information Communications Technology (ICT)

As can be seen from the list there is a great variety in the general naming of courses/programmes. A detailed look at the particular courses within each subheading reveals an even greater range of programme titles with programmes including combinations with other subjects.

25.1.2 Content, degrees and accreditation

The UK higher education system consists of two main cycles, undergraduate and graduate (or postgraduate), these correspond to the European First Cycle Degree (FCD) and Second Cycle Degree (SCD). FCDs are typically of 3-year or 4-year duration and classified as Bachelor of Science or Bachelor of Engineering usually, but not always, indicative of a scientific or engineering basis. SCDs are typically of 1-year or 3-year duration classified as Master of Science (MSc) or Master of Philosophy (MPhil) for the 1-year duration degrees and Doctor of Philosophy (PhD) for the 3-year degrees.
The 'value' of the FCDs is defined by the Quality Assurance Agency (QAA) in terms of credits. A FCD consists of 3 or 4 years of studies where each year must comprise 120 credits. A 3-year BSc or MEng therefore comprises 360 credits. This compares directly with the 180 ECTS for the same programme. The conversion is therefore 1 ECTS is equivalent to 2 UK credits. Masters level degrees are slightly different because the QAA defines that a Masters year should comprise **140 credits** (70 ECTS) to reflect the increased period of time spent studying for the qualification. One UK credit is approximately equivalent to an expected student workload of 10 hours, so one ECTS is equivalent to 20 student hours. This time comprises lectures, laboratories, assessments, lecture preparation, assessment preparation, assignments, etc.
Within the general quality and accreditation frameworks, each University has full autonomy to decide on the contents of each degree. Comparison between institutions and, to some extent courses within each Institution, cannot therefore be generalised too far.
Basic studies in engineering include mathematics, basic sciences and computer technology. After two years the studies become more subject-related. Students can choose specific study options within the degree programme. A Master's thesis is usually written during the final year of the studies.

25.1.3 Implementation of the Bologna-BMD system in United Kingdom

The current structure of higher education in the UK in which the first cycle degree is either 3 years (BSc, BEng) or 4 years (MEng) followed by a one year Master and a three-year Postgraduate PhD second cyle degree has a limited fit to the Bologna-BMD model.

25.2. Degrees in EIE in United Kingdom

The general requirement for entry to a first cycle degree in a higher education institution is the acquisition of the required A-Level UCAS tarif at a secondary school or college. The value of this tarif will depend on the programme and the University or College selected. There are no general rules that would be useful and the reader is recommended to refer to the UCAS web site and from there the specific academic institution for details of entry requirements.

25.3. References

This section has been compiled based on information from the following documents and weblinks:
UCAS website 2003: http://www.ucas.ac.uk
Other useful websites include :
UK government Quality Assurance Agency: http://www.qaa.ac.uk

3rd part

Final synthesis, references, acknowledgements

1. EU: Europe

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As a result of the study achieved, and as a complement to the first part of this document, it is possible to synthesise the following figures.

1.1. Figures on the weight of EIE in Europe

It is difficult to get exhaustive and undiscutable figures of the weight of our disciplines in the academic fields generally in Europe. The difficulties are:

- the fact to consider or not some curricula in which Electrical and Information Engineering are only a part (example: mechatronics, bioelectronics…),
- the fact to consider or not some professional curricula at the superior technician or the professional engineer level.

From the various figures available for the countries in this monograph, we may consider Electrical and Information Engineering represents 7 to 8% of the academic fields in Europe.

1.2. Degrees in EIE in Europe

The following table shows the names of the graduations, (in italic font), or the level (in normal font) of the available curricula in Europe.

Level	Secondary school + 2 (120 ECTS)	Secondary school + 3 (180 ECTS)	Secondary school + 4 (240 ECTS)	Secondary school + 5 (300 ECTS)
Name of the level	Superior Technician	Bachelor	"Intermediate level" (long Bachelor)	Master
	Professional	*Academic or Professional*	*Academic or Professional*	*Academic or Professional*
AT: Österreich (Austria)	*HTL Engineer*		*Dipl.-Ing. (FH)*	*Diplom Ingenieur*
BE: België/ Belgique/ Belgien (Belgium)		*Gegradueerde / Graduat*	*Industrieel ingenieur / Ingénieur industriel*	*Burgerlijk ingenieur / Ingénieur civil*
BG: България (Bulgaria)	Specialist level	Bachelor level		Magister level
CZ: Česká republika (Czech Rep.)		*Bakalář*		*Inženýr*
DE: Deutschland (Germany)			*Dipl.-Ing. (FH)*	*Diplom Ingenieur*
EE: Eesti (Estonia)		*Bakalaureusekraad*		*Magistrikraad*
ES: España (Spain)	*Formación Profesional*	*Ingeniero Técnico*		*Ingeniero*
FI: Suomi/ Finland			*insinööri* (*AMK*) or *ingenjör* (*YH*)	*diplomi-insinööri* (*diplomingenjör*)

FR: France	*DUT (Diplôme Universitaire de Technologie*	*Licence*	*Ingénieur-Maître*	*Master* or *Diplôme d'Ingénieur*
GR: Ελλάς (Greece)		*Diploma of TEI*		*Diploma of Engineering*
HU: Magyarország (Hungary)		Bachelor level		Master level
IE: Éire /Ireland		*Technician Engineer diploma*	*Bachelor*	*Master*
IT: Italia (Italy)		*Laurea di primo livello*		*Laurea specialistica*
LT: Lietuva (Lithuania)		Engineer level	Bachelor level	Master level
LU: Luxembourg			*Diplôme d'Ingénieur Industriel*	
LV: Latvia		*Bakalaurs*	*Bakalaurs*	*Maģistrs*
NL: Nederland (Netherlands)		Bachelor level	"Hogeschool" level	Master level
NO: Norge (Norway)		*Ingeniør*		*sivilingeniør*
PL: Polska (Poland)			*Licencjat* or *inżynier*	*magister inżynier*
PT: Portugal		*Bacharelato*		*Licenciatura*
RO: Rômania	*Tehnician*	*Subinginer*	*Inginer*	*Inginer* then *Masterat (sec. Sch. + 6)*
SI: Slovenija (Slovenia)			*diplomirani inženir elektrotehnike*	*Univerzitetni diplomirani inženir elektrotehnike*
SK: Slovensko (Slovak. Rep.)	*Technik*	*bakalár*	*bakalár*	*inzinier*
UA: Україна (Ukraine)	Junior specialist level		Bachelor level	Specialist level or Master level
UK: United Kingdom		*Bachelor of Engineering*	*Master of engineering or Master of Science*	*Master of Science*

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- http://www.zv.TUGraz.at/studabt/studienplaene_01_02/710.pdf.

2.3.2 BE: België - Belgique - Belgien

Education in the Flemish community:
- http://www.ond.vlaanderen.be/

Education in the French community:
- http://www.agers.cfwb.be/
- http://www.restode.cfwb.be

Société Européenne pour la Formation des Ingénieurs (SEFI):
- http://www.sefi.be

2.3.3 BG: България (Bulgaria)

- Higher Education, 2001, vol II, Ministry of education and sciences, under the edition of Prof. D. Dimitrov;
- Statute No 86 from 12th of March 1997 for validating of the government register of the education-qualification degrees in Higher Schools of Bulgaria Republic
- Statistical Yearbook, 1998, 1999, 2000, 2001
- Седмично издание АБВ, май 2002.

2.3.4 CZ: Česká republika (Czech Rep.)

- http://www.msmt.cz/ (Ministry of Education, Youth and Sports)
- http://www.msmt.cz/Files/vysokeskoly/Legislativa/HigherEduAct.htm (Higher Education Act)
- http://www.csvs.cz/_en/ (Centre for Higher Education Studies)
- http://www.czso.cz (Czech Statistical Office)

2.3.5 DE: Deutschland

- Quelle: "Studying in Germany" von DAAD. 6th Edition 1999
- Federal Ministry of Education and Research

2.3.6 EE: Eesti (Estonia)

- http://www.hm.ee/ (Estonian Ministry of Education)
- http://www.ekak.archimedes.ee (Higher Education Quality Assessment Council)
- http://www.ttu.ee/index_eng.html (Tallinn Technical University)

- http://www.ut.ee/english/ (Tartu University)
- http://www.itcollege.ee/inenglish/index.php (Estonian Information Technology College)
- http://www.tpu.ee/english.html (Tallinn Pedagogical University)

2.3.7 ES: España

- Draft of the University catalogue for the academic year 2002-03. Vicesecretariat of Studies. University Council
- La integración del sistema universitario español en el Espacio Europeo de Enseñanza Superior. Documento-Marco. Ministerio de Educación, Cultura y Deporte. Febrero, 2003.
- El grado en el Espacio Europeo de Educación Superior (EEES). Grupo de trabajo de la Conferencia de Rectores de las Universidades Españolas (CRUE) sobre Espacio Europeo de Educación Superior. 16 de marzo de 2003.
- Cifras de la educación en España, Las (Estadísticas e indicadores)'. Edición 2002 , Dirección General de Prog. Económica, Personal y Servicios. Ed. 2002 NIPO: 176-02-037-2 ISBN: 84-369-3565-9 Información y legislación educativa,
- Web of the Ministry for Education, Culture and Sport (MEC) at:
- http://www.mec.es
- Web of the University Council at:
- http://www.mec.es/consejou/index.html
- Statistics of the Ministry for Education, Culture and Sport (MEC) at: http://www.mec.es/estadistica/p_estadist.html
- Statistics from the University Council:
- http://www.mec.es/consejou/documen/pubestad.html
- Obtainable degrees, classified on a degree as well as awarding University basis at: http://www.mec.es/consejou/oferta/index.html
- Specific guidelines on a degree basis at:
- http://www.mec.es/consejou/titulos/boestitu.html

2.3.8 FI: Suomi/Finland

- http://www.minedu.fi/minedu/education/
- http://www.hut.fi/English
- http://www.lut.fi/english/
- http://www.tut.fi/public
- http://www.ttk.oulu.fi/English/
- http://www.abo.fi/aa/engelska/

2.3.9 FR: France

- Diplômes délivrés dans les spécialités Electrotechnique, Electronique, Automatique; Communication et Informatique, bacc+2 à bacc +5, années de référence 1999 et 2000, CEFI, FIEEC,
- Ministère de l'enseignement supérieur,
- Website of CEFI : http://www.cefi.fr,
- Repères et références statistiques - édition 2001.

2.3.10 GR: Ελλάς (Greece)

Book:

- "Higher Education – Universities and Technological Educational Institutes"
- Hellenic Republic, Ministry of National Education and Religious Affairs Edition 2003, Athens ISBN 960-87088-1-8

Websites:

- Ministry of National Educatoin and Religious Affairs: http://www.ypepth.gr
- Euroeducation: http://www.euroeducation.net/prof/greece.htm

2.3.11 HU: Magyarország (Hungary)

- Sima, D.: On the the two-cycle higher education in technology (Gondolatok a kétlépcsős műszaki felsőoktatásról, in Hungarian), © Magyar Akkreditációs Bizottság, 2002,
- Felsőoktatási felvételi tájékoztató, Oktatási Minisztérium, 2003. 06. 02.
- http://www.mab.hu/doc/bologna.doc
- http://www.felvi.hu
- http://www.usc.edu/dept/education/globaled/wwcu/background/Hungary.htm

2.3.12 IE: Éire /Ireland

- Institution of Engineers of Ireland, which is the professional engineering body in Ireland. The web address is http://www.iei.ie/

2.3.13 IT: Italia

- http://www.miur.it/, Ministry of Education, University and Research
- http://www.miur.it/ustat/, Ministry of Education, University and Research
- http://almalaurea.cineca.it/universita/profilo/profilo2001/dati/laureatiper_cdl.html

2.3.14 LT: Lietuva (Lithuania)

- http://www.inf.vtt.fi/pdf/tiedotteet/2002/T2169.pdf

2.3.15 LU: Luxembourg

- Guide des études / Studienführer 2001/2002 - Institut Supérieur de Technologie/Fachhochschule Luxemburg/ Luxembourg University of Applied Science, Luxembourg, 2001.

2.3.16 LV: Latvia

- Ministry of Education and Science http://www.izm.lv/en/default.htm

2.3.17 NL: Nederland

- http://www.el.utwente.nl/index_uk.htm, http://www.el.utwente.nl/en/study_programmes/
- http://www.tudelft.nl/matrix/info.cfm?PageID=3916&usertype=english

2.3.18 NO: Norge/Noreg (Norway)

- http://www.studmag.no/lenker/article.jhtml?articleID=19593&fraAvis=ap
- http://www.nationmaster.com/country/no/Economy
- http://populations.com/country.asp?ID=126
- http://www.studmag.no/lenker/article.jhtml?articleID=19816&fraAvis=ap
- A classic paper on the evolving new educational system in Norway by Prof. Einar Aas, "ENGINEERING EDUCATION IN NORWAY", A report prepared for the European Commission to the Conference of European Schools for Advanced Engineering Education and Research - CESAER, 1995.
- http://universitet.no/n.nsf/alt/54CDHM
- http://www.euroeducation.net/prof/norco.htm
- http://www.nsd.uib.no/english/
- http://www.utdanning.no
- http://odin.dep.no/odin/engelsk/norway/index-b-n-a.html

2.3.19 PL: Polska

- Small Statistic Yearbook, edited by GUS
- Polish Ministry of Education and Sport:
- http://www.men.waw.pl/,
- http://www.msz.gov.pl/mszpromo/en/1_3.htm
- http://elt.britcoun.org.pl/e_poland.jpg

2.3.20 PT: Portugal

- http://www.mces.pt/

2.3.21 RO: România

- http://www.pub.ro -- site of University Politehnica of Bucharest
- http://cs.pub.ro/ -- site of Automatic Control and Computers Faculty
- http://www.electronica.pub.ro -- site of Electronic and Telecommunication Faculty
- http://www.edu.ro/ -- site of Education and Science Ministry in Romania

2.3.22 SI: Slovenija

- Annual Report, Research activities 2002, Faculty of electrical engineering and computer science, University of Maribor

- Research and development at the Faculty of electrical engineering in Ljubljana, 2002, Faculty of electrical engineering, University of Ljubljana
- information available on the web pages of the faculties

2.3.23 SK: Slovensko (Slovak rep.)

- http://www.elf.stuba.sk
- http://www.utc.sk
- http://www.tuke.sk
- http://www.tnuni.sk
- http://www.education.gov.sk
- “Separát štatistickej ročenky školstva SR 2001“ – vysoké školy, („Statistical Annual Report for HE of the Slovak Republic”) published by the „Institution for the information and prognoses in HE", Bratislava, 2002

2.3.24 UA: Україна (Ukraine)

- Ministry of Education and Science of Ukraine http://www.education.gov.ua

2.3.25 UK: United Kingdom

- UCAS website 2003: http://www.ucas.ac.uk
- UK government Quality Assurance Agency: http://www.qaa.ac.uk

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