Appendix A Course profile

Note: This course profile will be updated during study year 2018 – 2019

Planning in chapter 3.8 is not up-to-date. Check yearschedule for current planning.

Fontys Hogeschool Engineering

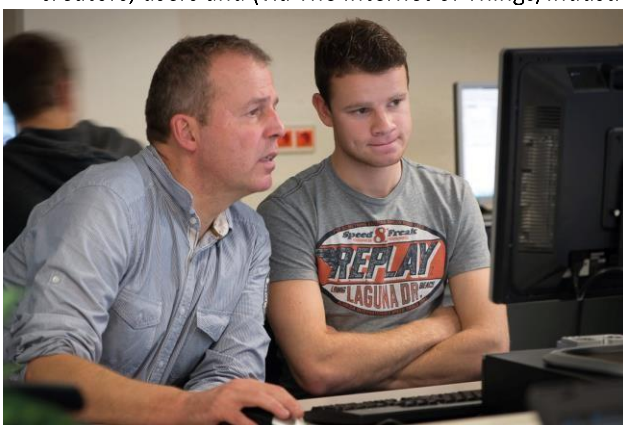
Course Profile
Bachelor of Science (BSc)

Automotive
Electrical Engineering
Mechatronics
Mechanical Engineering

Table of Contents

1. Introduction

Association of Universities of Applied Sciences (formerly HBO council) prepared a competence based profile description for the Engineering domain for the title Bachelor of Science (BSc), which replaces the title of Bachelor of Engineering from September 1, 2015 (BEng). In Eindhoven this has been formed in a number of contemporary technical courses, developed by Fontys School of Engineering Automotive (Automotive course) and Fontys School of Engineering (Electrical Engineering, Mechatronics and Mechanical Engineering). One by one state-of-the-art engineering courses, which optimally responds to current market trends under the umbrella denominator Fontys School of Engineering (FHEng). Pure electrical or mechanical 'mono-solutions' are no longer important. Take for example smartphones, automobiles, industrial robots, process instrumentation, manufacturing, as well as washing machines and refrigerators. Almost all devices have already advanced (digital) sensor and control technology that works closely with smart and compact (electro) mechanical components. Moreover, via wireless connections (GSM, WiFi) systems communicate increasingly with their creators, users and (via The Internet of Things/Industry 4.0) even with each other.



GROWING NEED FOR TECHNICIANS

Due to these unstoppable developments it is not for nothing that digital technology/communications and mechatronics belong to the fastest growing fields. This has resulted, inter alia, that there currently is a serious shortage of specifically skilled engineers/technicians.

Regarding the development and implementation of the courses FHEng works closely with the industry. There is not only an inspiring synergy here, but also a good connection of (les) theory to daily practice. Partly because of this a graduated 'Fontys Engineer' usually finds a good job with excellent career prospects quite fast. What of course also greatly contributes to that is that FHEng operates in a very inspiring technologically environment, right in the center of 'High Tech Netherlands' and the Brainport region. In addition, the Engineering courses close seamlessly to the government's Top Sector policy and in particular in the area of the Top Sector: High Tech Systems & Materials (HTSM). Fontys educates her engineers very versatile. This makes them valuable participants of, for example, multidisciplinary and interdisciplinary project teams conducting groundbreaking research and/or responsible for the development of new product and system generations.

FLEXIBLE COMPETENCE MODEL

The course profile which FHEng uses in four Engineering courses is based on the national competence model Engineering [1], which is designed for any education that gives the right to use the title Bachelor of Science. Because the courses organized in accordance with the competence model are spread throughout the Netherlands, the competence model need to 'be flexible' and tailored to both the nature of the course as the needs and opportunities of the regional business community. In the orientation phase, Engineering students can verify whether their initial choice meet their expectations, with the possibility to switch if desired. Partly due to that a responsible decision about the final specialization can be taken in a later stage. Because Fontys School of Engineering operates in one of the most technologically advanced regions of the Netherlands, the content and level of courses are at a unique level, which provides an excellent base for a successful career as an engineer.

2. Educational Model Engineering

The educational model used by FHEng is continuously updated based on new developments both didactic (modern education) and content wise (the rise of 'High Tech Systems', new materials, etc.). But also a greater involvement of and cooperation with the business community means that the composition of the education model is constantly changing. In addition, for the various courses a clear mission, vision and ambition is defined by a multidisciplinary team composed by Fontys ranks. In short it comes down to this:

2.1 Mission

FHEng strives to be a 'state of the art' educational institute for engineers-to-be, emphasizing on the important work of the Top Sector: High Tech Systems & Materials (HTSM) during the various courses. Also, with the targeted courses, FHEng wants to be included in the 'Top 3' of the best HBO institutions of the Netherlands.

2.2 Vision

FHEng educates her students to become 'competent professionals' to work successfully in the field of technique and to make an essential contribution to both the Dutch society cq. the rural economy and also to (inter)national and regional business.

2.3 Ambition

To meet the need for well trained technicians in the region and beyond FHEng wants to develop into a leading knowledge center of the manufacturing industry in the Southern Netherlands with modern and attractive education, taught by passionate professionals.

2.4 Educational Model

FHEng applies one educational model to all courses, which is shown schematically in the following figure.

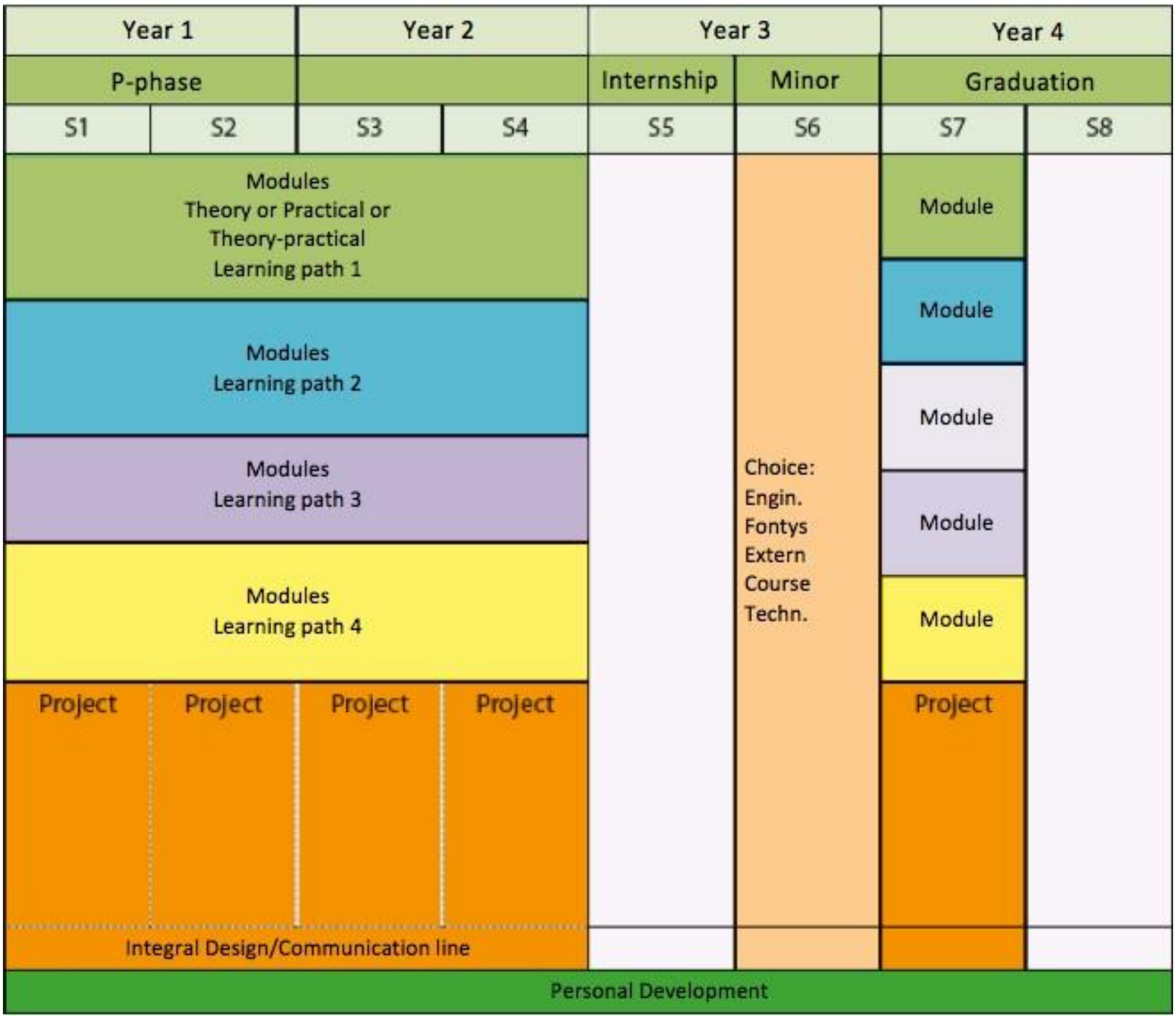
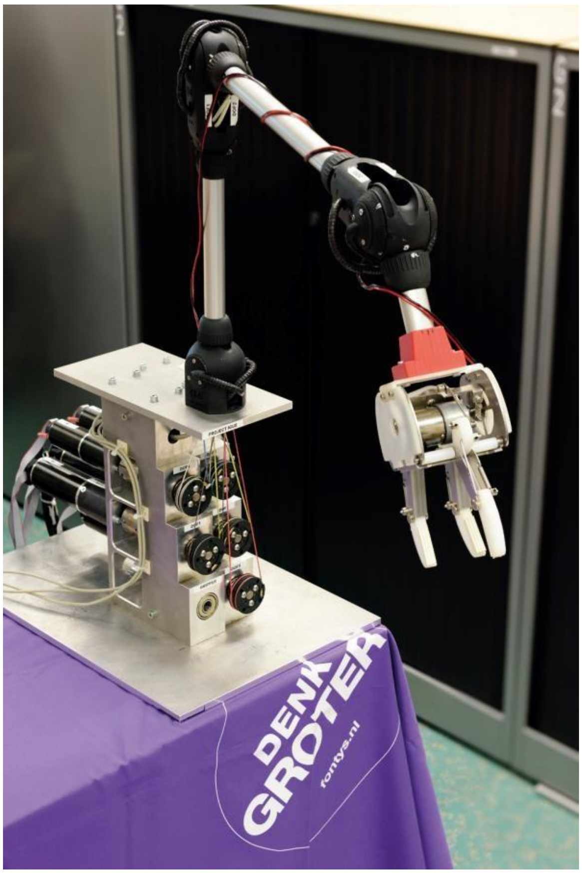


Figure 1 Curriculum model Engineering courses

3. Establishment of the educational program

FHEng offers four Dutch courses, namely:
Automotive (A), Electrical Engineering (E), Mechatronics (M) and Mechanical Engineering (W). In addition, FHEng has three English courses, namely Electrical & Electronic Engineering (EE), Mechatronics Engineering (MEE) and Mechanical Engineering (ME). The curriculum of the individual courses is defined within the frames of the educational vision. The fact that a competence based curriculum is chosen entails that students can indicate that they have specific knowledge and skills in the context of the professional situation. For this reason, the curriculum is chosen for a 'block' of projects that globally covers 1/3 of the total curriculum. The remaining portion (2/3) is occupied by modules, in which the learning paths are visible. Parallel to the content modules and projects there is personal development throughout the entire study.



3.1 Learning Paths

The modules are divided into learning paths[2] with visible areas of expertise (construction, process & energy, analog design, system engineering, etc.). The modules are mainly focused on knowledge and skills that are also part of the competence acquisition. The projects are integrative of character. In projects students work in a context which is similar to that in professional practice. The projects can be both monodisciplinary as interdisciplinary or multidisciplinary. Especially in projects students can show specific competences on a certain level.

3.2 Individual learning style

Diverse work methods are consciously chosen within FHEng. Per study unit the most appropriate working method for the corresponding group and corresponding study unit is chosen in order to achieve the learning objectives. A variety of didactical methods also reflect the fact that not every student has the same learning style. Various work methods are used within the modules, such as lectures, classroom lessons, instructions and accompanied and unaccompanied practicals. Teamwork is central to projects.

3.3 Internships

Internship and graduation are an integral part of the curriculum. Internships generally take place in professional practice. The internship is exploratory in the professional practice and is the first opportunity to test some part qualifications of the course in professional practice. The internship can take place in a company, but also within a professorship or a research institute. In terms of content a company supervisor accompanies the student during the internship. The school counselor is responsible for the process management.

3.4 Graduation

Graduation generally takes place in professional practice, but can also take place within a research group environment, Centre of Expertise (CoE), University- or research environment (TU/e, TNO, etc.). Prior to implementation, the thesis topics are judged on their (bachelor)level and (engineering) relevance by the graduation coordinator in consultation with the subject teachers. It is essential that the thesis is a

[2] coherence between subjects/modules of learning fields

representative engineering thesis so the student can prove to have the intended final qualifications of the course. The company supervisor provides the substantive guidance of a graduation project, the school counselor is responsible for the process management.

FHEng offers one freely selectable minor in semester 6 of the study program, which can be chosen from the following options:

- Engineering Minor
- Fontys minor
- External minor via kiesopmaat.nl
- Minor training in Technical Professions

3.5 The educational process

Students themselves are owners of their individual learning process. In this context FHEng has chosen for a person-centered approach, in which students are encouraged to self-responsibility, individual development and active learning.

FHEng seeks so-called feasible education. Within personal development, active and regular learning behavior is stimulated by focus on learning to learn. In order to enable students to plan and execute their study activities there are semester manuals, in which the learning objectives, student activities, teaching materials and testing and assessment are described. Also the timetables are available in time.

3.6 Excellence paths

For more talented students FHEng provides various excellence projects on top of the regular curriculum. For Electrical Engineering, Mechatronics and Mechanical Engineering this is PROUD (Outstanding Development Program) for Automotive ACE (Automotive Centre of Expertise) where, by performing additional work and assignments, students may obtain the excellent predicate. In addition, for excellent students within various courses, there is a bridging program 'HBO TOP', which enables direct access to the Master's program at the TU/e.

3.7 Personal development

Teachers/staff instruct, advise and guide students content and process (study activities, study approach) with their learning process. Instruction, advice and guidance are linked to the work methods, such as instruction in classes and practicals, advising project groups and internship counseling. There is explicitly attention for personal development in the curriculum. Each student has a personal development tutor who has attention for things like personal issues, study progress and approach and competency/professional development of a student. The offered study program connects to the formulated entry requirements for HAVO, VWO and MBO. Selection, professional orientation, study orientation and 'reference to' form part of the propaedeutic phase.

3.8 Phasing of the education implementation

All semesters are performed once every year. Each semester represents a study load of 30 ec or 840 study load hours. The school year is divided into four periods (quarters) of ten weeks, whereby each quarter consists of seven lesson weeks[3], one self-study/spout week and two weeks for assessment and project completion.

4. Competence development

Engineers should have some specific competences and behavioral characteristics. These are of crucial importance for proper performance of his or her work in the profession. Of course, the emphasis will hereby vary and also depend on the type of function that students will exercise in professional practice. In context of

[3] Automotive has 8 lesson weeks and 2 weeks for assessment and project completion

the pursuit to give students of FHEng the widest possible luggage, the focus during the courses lies on the development of some specific skills and behavioral characteristics.

4.1 Analyze

Analyzing an engineering problem involves the identification of a problem/issue or customer need. Based on this, possible design strategies and solutions are formulated and is determined what the requirements/objectives and constraints are. Here a wide range of methods and techniques are applied, including mathematical analysis, computer models, simulations and practical experiments. Economic and commercial aspects, but also impact on people, society, health, safety, environment & sustainability are also involved in the decision model. The following behavioral characteristics play an important role:

- Select relevant aspects of the issue.
- Report the possible impact on economic, social and field related aspects.
- Formulate a clear problem, objective and contract based on the wishes of the customer.
- Prepare a program of (technical & non technical) requirements, and record this in a clear way.
- Modelling an existing product, process or service.

4.2 Design

The realization of a design and working directly with engineers and other disciplines (marketing, sales, service) is an important skill of engineers. The design can be realized for a device, system, process or method and can be much more than a technical design alone. In addition the engineer will have feeling and attention for the impact of (parts of) the design on the social environment, health, safety, environment, sustainability (cradleto-cradle), not to mention the commercial feasibility. While designing the engineer uses his/her knowledge of design methodologies and knows well how to fit in the right context. The design to be realized is based on the program of requirements and forms a complete and correct implementation of all established requirements. The engineer for this include the following behaviors:

- Develop and visualize a concept solution (architecture) based on analyzes and requirements established by others.
- Create detailed (sketch) designs according to the chosen concept solution and then elaborate (in 3D).
- Assess the manufacturability and testability of the design in the design phase.
- Verify the design according to the program of requirements.
- Selecting the right design tools.
- Setting up report and documentation for the product, service or process.

4.3 Realize

This is defined as the realization and delivery of a product or service, or the implementation of a process that meet the requirements. The engineer is developing practical skills for solving engineering problems and performs researches and tests. These skills include, inter alia, knowledge of specific properties and the use of materials, the use of computer simulation models, engineering processes, equipment, consult focused on technical literature and information sources. Bachelors are also able to oversee (mostly non-technical) impact of their activities, for example in the area of ethics, social environment and sustainability. For this purpose the following behavioral characteristics are important:

- Appropriate use of materials, processes, methods, norms and standards.
- Assembling components into an integrated product, service or process.
- Verify and validate the product, service or process in compliance with the requirements.
- Document the realization process.

4.4 Control

This is defined as optimal functioning of a product, service or process in its application context or work environment. Hereby taking the following aspects into account in the field of safety, the environment and both technical as economic durability. For this the engineer possesses the following behavioral characteristics:

- Able to enter, test, integrate and commissioning a new product, service or process.
- Contribute to management and/or maintenance plans. Both corrective (monitoring, detection and optimization) and preventive (anticipation).
- Test the performance of a product, service or process on certain quality criteria.
- Provide feedback in response to changing circumstances and/or the performance of a product, service or process.

4.5 Manage

Engineers give direction and guidance to organizational processes and involved employees to realize the goals of the organizational unit and/or the project they lead. Based on his/her behavior characteristics the engineer is able to:

- Set up a (sub) project, which include aspects such as the quantification of time and financial budget and balancing and quantification of risks. This also includes set up of project documentation and organizing the resources (people & resources) necessary for the project realization.
- Monitoring activities and, if necessary, adjust the schedule in terms of time, budget, quality, information and organization.
- Communicate task- and process-oriented.
- Organize meetings and lead as chairman.
- Guide employees, encourage cooperation and to delegate timely and meaningful.
- Communicate and collaborate with others in a multicultural, international and/or multidisciplinary environment and thereby meet the requirements which is set to employees participating in a work organization.

4.6 Advise

Engineers give well-founded advice on the design, improvement or implementation of products, processes and methods and make profitable transactions with goods or services. For this purpose, the following behavioral characteristics are important:

- Being able to empathize with the position of the internal or external customer.
- Clarify what exactly entails the need of the client.
- Translate customer needs in consultation with relevant parties into technical and economical feasible solutions.
- Substantiate an advice and convince the customer of this.
- Maintain relationships with customers in an adequate manner.

4.7 Research

Engineers have a critical research attitude and use appropriate methods and techniques in respect to gather and assess information to be able to carry out applied research. The methods used here may include literature research, designing and conducting experiments, interpreting data, implementation and evaluation of computer simulations. Consulting databases, standards and (safety) norms. Based on specific behavioral characteristics the engineer is able to:

- Formulate the objectives from the question of a desired research.
- Select and consult (scientific) literature and own/other sources of information independently in order to delve further into the issue. The engineer is thereby able to validate the reliability of various sources of information to the right value.
- Summarize the results, structure and interpret and draw conclusions in relation to the research question.

- Report results in accordance with the standards applicable in the field.
- Critically evaluate the chosen approach based on the obtained results and, if necessary, make recommendations for targeted follow-up research.

4.8 Professionalize

With professionalization we mean acquiring and maintaining the skills needed to effectively carry out engineering skills. These skills can also be applied in a wider context, such as possessing an international orientation and the ability to insert the latest developments correctly. We are talking for example about the relationship of certain designs and developments to social norms, values and ethical dilemmas. Based on specific behavioral characteristics the engineer is able to:

- Determine and execute a learning objective and learning strategy independently and link the result to the learning objective.
- Being flexible in a variety of professional situations.
- Able to weigh professional and ethical dilemmas and make a decision, taking accepted norms and values into account.
- Provide and receive constructive feedback on both behavior and content.
- Reflect on their actions, thoughts and results.
- Handle various forms of communication and means in order to communicate effective in both Dutch and English.

4.9 Distinguishable levels

Level 0:
Intake Level (havo-5/mbo-4 final level)

Level 1:
Kind of task: Simple, structured, applies known methods directly according to established standards.
Kind of context: Known; simple, mono-disciplinary, in school situation. Degree of independence: Steering guidance.

Level 2:
Kind of task: Complex, structured, adjusts well-known methods to varying situations.
Kind of context: Known; complex, mono-disciplinary, under supervision in practice. Degree of independence: Guidance if necessary.

Level 3:
Kind of task: Complex, unstructured, improves methods and adjusts norms to the situations.
Kind of context: Unknown; complex, multidisciplinary in practice. Degree of independence: Independent.

5. Connection to the professional field

A lot of attention is given to practical education during the courses of FHEng, which also characterizes the strong professional character of HBO courses. The great need for HBO engineers has also led to more and more active participation of companies in training engineers. The curriculum of FHEng also connects with the current spearhead areas within the region. During education professional practice is simulated by means of (real and/or simulated) projects. The projects are carried out by interdisciplinary or multidisciplinary project teams (which is similar to professional practice). Each project member is responsible for a partial aspect of the project that eventually leads to an adequate end result by the entire project team.

What should we think of regarding vocational projects? For example:

- Develop a medical device, which creates a pleasant environment in an MRI and CT scanner by spreading fragrance.
- Develop a robotic prothesis for the forearm.
- Design the product life cycle of a factory facility for making refrigerated containers.
- Develop a plastic product including the production and determination of the total life-cycle costs (TLC) for the replacement of an existing metal product.
- Design and realize a lightweight and easily adjustable brace.
- Investigate the potential for product innovation for an LCD panel, focusing on the entire product life cycle (Cradle to cradle).
- Investigate and optimize the service and maintenance processes, and give feedback to the design and production departments.
- Examine the efficiency of buying and sales and make suggestions for improvement, taking all stakeholders into account.
- Research on and reduce energy consumption of the production of a certain type of product and making suggestions for improving the design and the other product life cycle phase.

6. Course offer

6.1 Introduction

FHEng provides the following four dutch courses, which are registered at the 'Centraal Register Opleidingen Hoger Onderwijs' (CROHO):

- Automotive
- Electrical Engineering
- Mechatronics
- Mechanical Engineering

The planning/content for each school year:
School year 1: Preparatory phase
School year 2 and 3: Main phase
School year 4: Graduation phase

In the following chapters the various courses are discussed. Each chapter closes with a so called competence spiderweb. This will give you an impression of the skills that can be expected from the engineers who have succesfully completed the corresponding course. In one course the emphasis lies more on analyzing, while in another course the managing or controlling may be more important. For prospective students the competence spiderwebs can be used as a guideline for comparing their personal character and skills with the competencies to be developed during the course.

6.2 Automotive Course

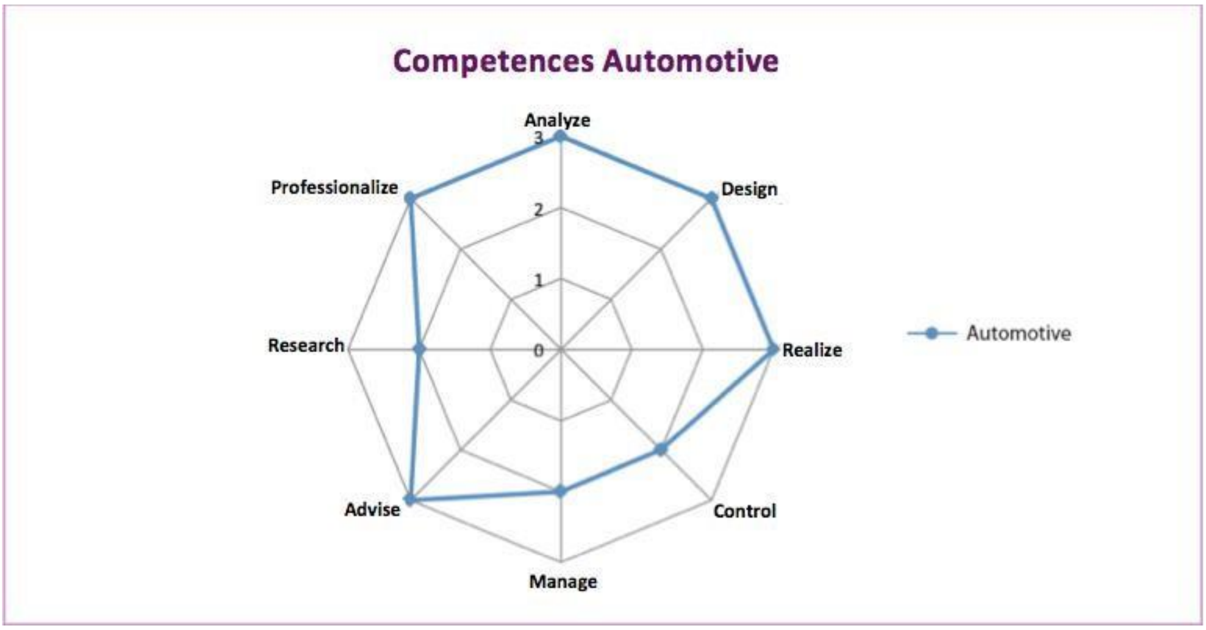
Vehicles today are clever combinations of various techniques and systems. Mechanical, hydraulic, pneumatic/vacuum, electrical, electronic (analog and digital). All these disciplines and combinations are to be found in today's vehicles. Additionally the sensors, actuators, GPS systems, computers, communication systems, etc. of vehicles are increasing. Besides models with 'conventional engines' there are now hybrids, fully electric vehicles, "clean diesel cars", cars with super efficient Eco petrol engines, cars with light, stiff and strong aluminum bodies. In short, the today's automotive engineer has to be an all-rounder. The Fontys Automotive course offers a broad training profile and focuses specifically on both the design, production, optimization and testing of vehicles and vehicle systems. Graduated automotive engineers usually end up in a development (Development Engineer) or production environment (Manufacturing Engineer).

A Development Engineer develops and designs new vehicle parts and/or makes improvements to existing components and systems (value analysis). Nowadays, this is more about intelligent vehicle systems, whereby the integration of different disciplines, including mechanical engineering, electrical engineering and information technology plays an important role. This multidisciplinary approach is a typical feature of today's automotive engineer, while (computer) simulation and performing targeted tests are also important elements within a product development process. Also new products can be developed by for example combining existing possibilities with new (production) techniques and/or new materials. But the activities can also lie more on Research & Development (R&D). Thereby think, for example, of the development of a simulation model that allows the cylinder head temperature to be predicted based on heat supply from the combustion on the one hand and on the other hand the heat transfer through the cooling fluid to the cooling system.


apollo

Manufacturing engineers operate more in the production environment and are closely involved in optimal tailoring of different subsystems. Thereby cooperating closely in line with Development Engineers, but also with engineers from the production and logistics departments. There will be worked on, inter alia, techniques to produce faster and less expensive vehicles without compromising on quality and reliability. Robotics and advanced logistic systems in conjunction with automated assembly lines play a crucial role in this.

Graduated automotive engineers find a job in one of the many automotive companies in the heart of the Brainport Automotive from the Netherlands, or at leading automotive companies in the countries around us. Given the rapid innovations that characterize the automotive industry by definition, there is a continuously strong demand for well-trained engineers in this sector.



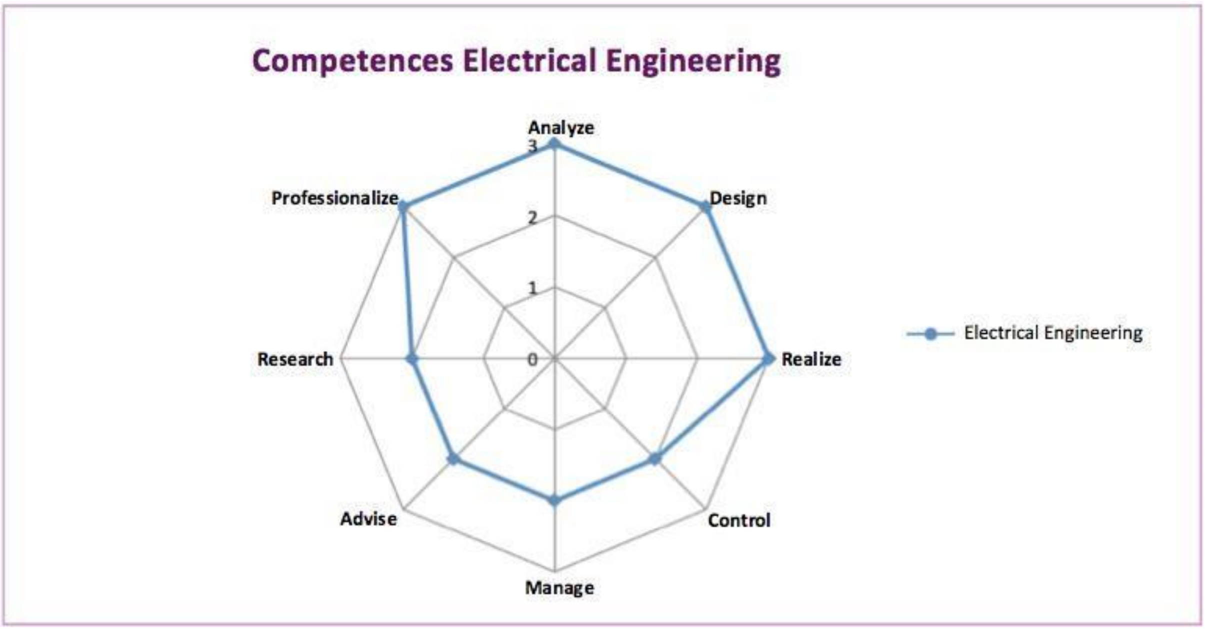
	18 - 24 points	End level Automotive
1	Analyze	3
2	Design	3
3	Realize	3
4	Control	2
5	Manage	2
6	Advise	2
7	Research	3
8	Professionalize	3
		21

6.3 Electrical Course

Electrical Engineering is engaged in research, analysis, design and construction of electrical systems, based on the theory of electromagnetism and analog and digital electronics. In a wide range is worked on electromagnetic-related issues, products, processes and/or services.

An electrical engineer usually works from a problem situation to resolve an electrical problem. This solution can result in a new design, but also in research, or redesign, improve/optimize existing products, systems, processes and services. Hereby the electrical engineer makes use of relevant methodologies (V model), structured analog, digital and/or embedded design, control or power electronics/power transmission. Here, the engineer works on both component level (semiconductors, chips, microprocessors, etc.), as on system level. In addition, electrical engineers also work in technical/commercial functions and within environmental- and advisory organizations.

The field of electrical engineering is subject to rapid developments and innovations. An important factor in this is the progressive miniaturization, whereby electronic/digital circuits with increasing complexity in ever smaller surfaces (nanotechnology) can be realized. Think of the use of FPGA's, System on Chip, etc.). There are countless examples of electrical products and systems in daily life. Think of GPS, HDTV, smart phones, tablets, computer homecare applications, solar energy, Domotica, control systems (CV/security via smartphone), etc. The field of electrical engineering is also incredible wide. There are professional opportunities as a designer, researcher or project leader in direct electrical engineering or at the intersections with other disciplines including mechatronics, embedded systems, medical technology, etc. But also management and commercial functions audio/video technology are among the possibilities. Career opportunities lie both within SMEs and larger companies such as Philips, ASML, OCE, Vanderlande Industries and suppliers as Neways, Prodrive, ADEAS, NXP etc.



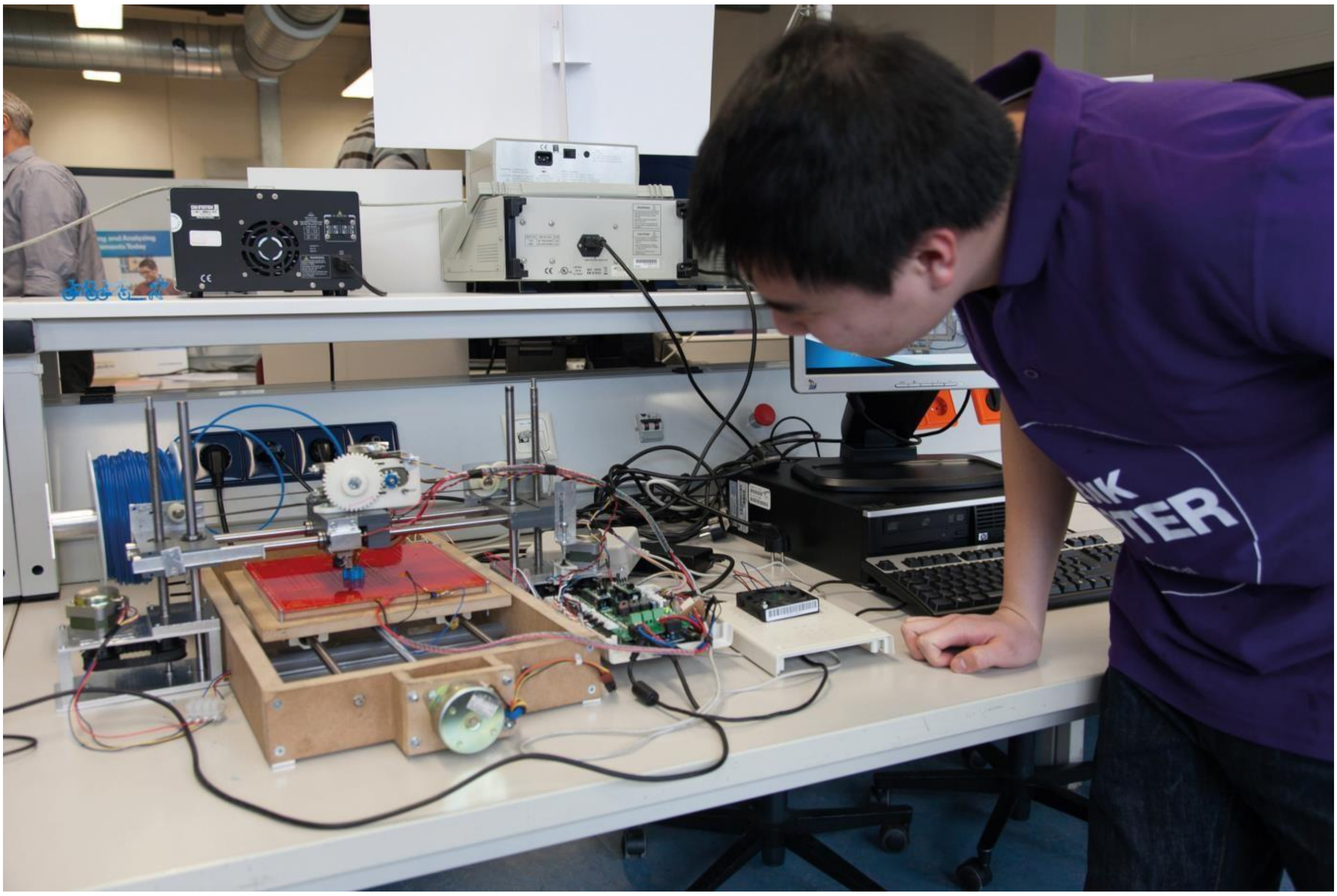
	18 - 24 points	End level Electrical Engineering
1	Analyze	3
2	Design	3
3	Realize	3
4	Control	2
5	Manage	2
6	Advise	2
7	Research	2
8	Professionalize	3
		20

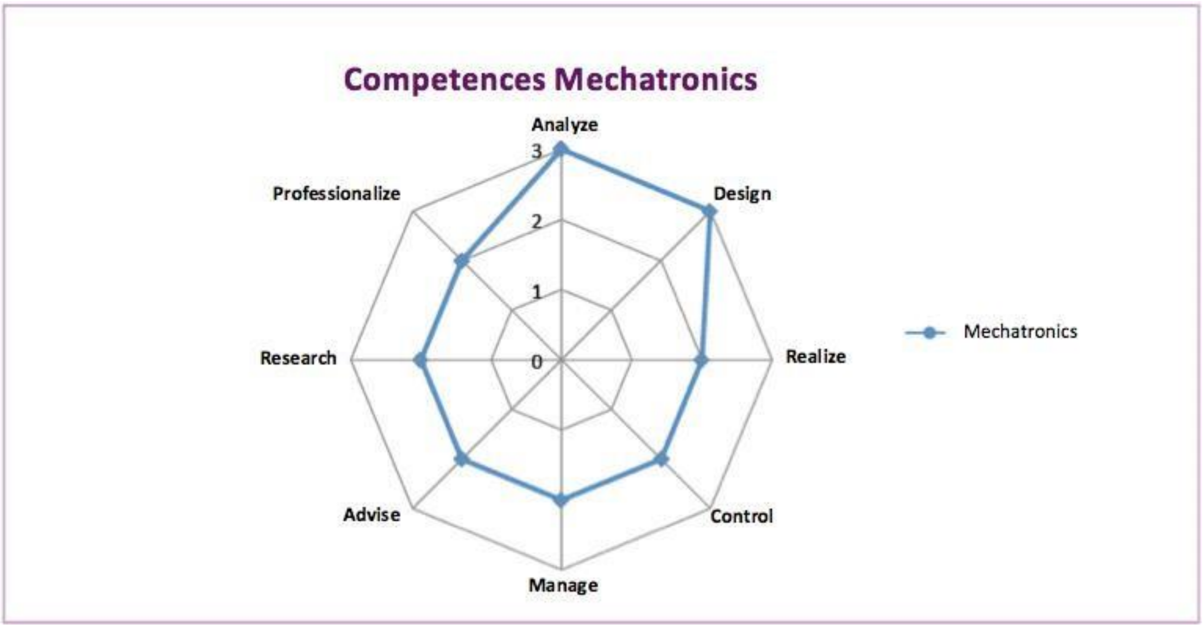
6.4 Mechatronics Course

Mechatronics is an interdisciplinary, cross-border field involving functional combinations of elements of mechanical engineering, electrical engineering, (technical) physics and (technical) information technology. Mechatronics approach a (design) problem systematically through an integrated approach taking advantage of smart functional couplings of, inter alia, (electro) mechanical, pneumatic, hydraulic, and digital techniques.

The industrial automation world now has a wide range of systems and control components including PLC's, IPC's, sensors, actuators, vision systems, etc. The mechatronics focuses less on the development of individual building blocks, but rather on combining them in the right combination (system integration). Other products are direct results of the ingenuity and design strength of mechatronics, such as the robotic arms of the Da Vinci surgical robot, which now enables surgeons to operate in our body with minimal interventions. Also think of mechanical devices for disabled persons. Thereby the field has much overlap with robotics, but also the manufacturing industry and, for example, in cars are found many mechatronic applications.

Mechatronics can be employed in the entire chain from research and design to management and maintenance and (design for) disposal and reuse (recycling) products and systems. Examples of typical work environments for mechatronics are engineering firms, companies and suppliers in the industrial automation, machine building and equipment building, production companies, knowledge institutions, (applied) research and suppliers/producers of consumer items.





	18 - 24 points	End level Mechatronics
1	Analyze	3
2	Design	3
3	Realize	2
4	Control	2
5	Manage	2
6	Advise	2
7	Research	2
8	Professionalize	2
		18

6.4 Mechanical Engineering Course

The field of mechanical engineering includes researching, designing and realizing a wide range of products, structures and related processes and/or services.
The mechanical engineer is (traditionally) mostly responsible for the structural aspects, mechanical parts, choice of material, production technology, measurement and control and energy management. The challenge here is to find user-friendly, safe, durable, low-maintenance, well organisational and social and economically viable solutions.

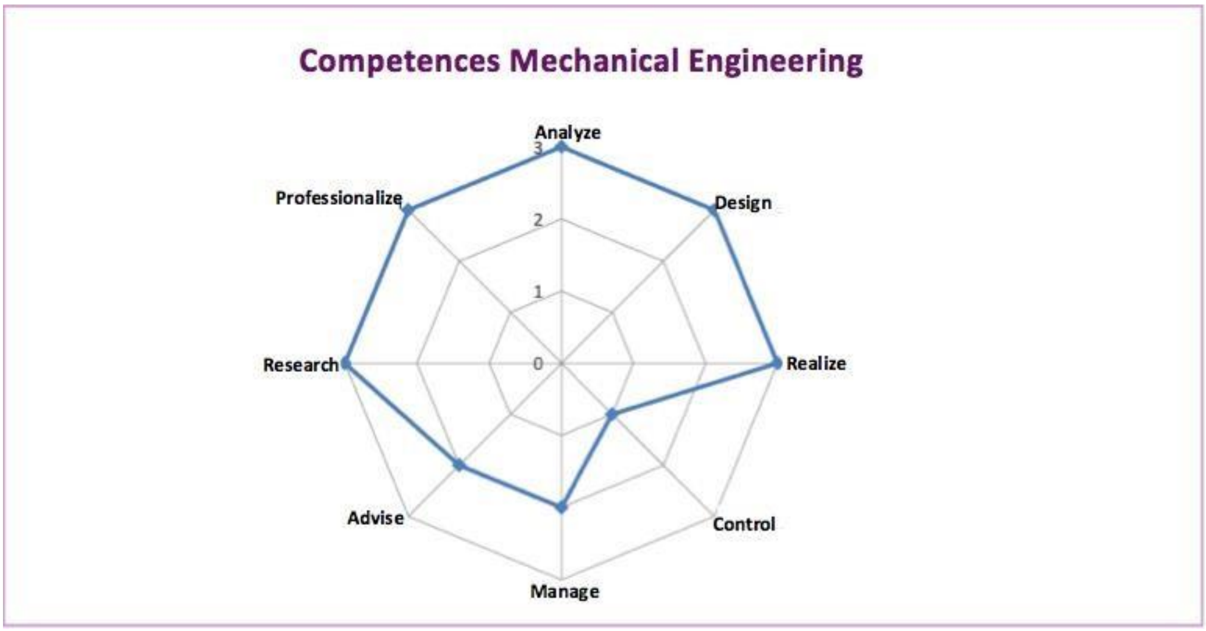
Mechanical engineers realize (usually in collaboration with other specialists such as electricians, mechatronics and material experts) various technical products, processes and technology related services. They thereby take responsibility for the mechanical aspects such as construction, mechanical parts, the materials to be used and production techniques. In addition, other aspects also play a role such as measurement and control, energy management, service and maintenance and there must be attention for technical/economic aspects.

The scope of the mechanic is extremely broad, which means that for every graduated mechanical engineer it will not be difficult to find an interesting job. Mechanical engineers are for example active in research, (re)design and realization of simple products such as a purely mechanical scissors, to more complicated consumer products such as smart razors and smartphones. The mechanical engineer has hand in the development of a wide variety of machines and devices such as HDD-recorders, rocket engines, aircraft, microscopes, a new roller coaster at an amusement park, the steel structure for a high-profile residential tower, etc. But also in the design and construction of production and processing such as an assembly line (freight) cars, a water treatment plant or a climate control system, the mechanical engineer is an important player. In addition, mechanical engineers can play an important role in the development, implementation and execution of related (supporting) processes and services such as market research, buying, sales, service, maintenance, organization, project management, etc.

The mechanical engineer can look forward to an interesting career in both small and large companies and agencies that deal directly or indirectly with mechanical oriented activities. So also where technical plants and/or products are used such as hospitals, hotels, but also (cruise) ships, the mechanical engineer is a valued colleague.

Some examples of 'mechanical' functions or professions are:

- Technical/commercial manager for market research, buying/selling of technical products.
- Researcher of new technologies and products.
- Designer of products, machinery, production facilities.
- Manager for planning, execution and optimization of the production
- Manager for service and maintenance and/or the coordination and organization of commissioning complex machines and devices.



	18 - 24 points	End level Mechanical Engineering
1	Analyze	3
2	Design	3
3	Realize	3
4	Control	1
5	Manage	2
6	Advise	2
7	Research	3
8	Professionalize	3
		20

Sources

[1] Bachelor of Engineering, a competence related profile description. Domain HBO Engineering. November 2012.

Appendix

Appendix 1: Procedure for competence acquisition and assessment

Digital portfolio, personal development and competence acquisition in Fontys Bachelor of Engineering.

Assumptions:

1. The occurrence of significant knowledge and skill gaps are covered with knowledge learning and summative knowledge and skill tests.

2. Competence acquisition is incorporated in the curriculum in a natural way with real professional roles (Content and process roles) in projects with professional practice situations.

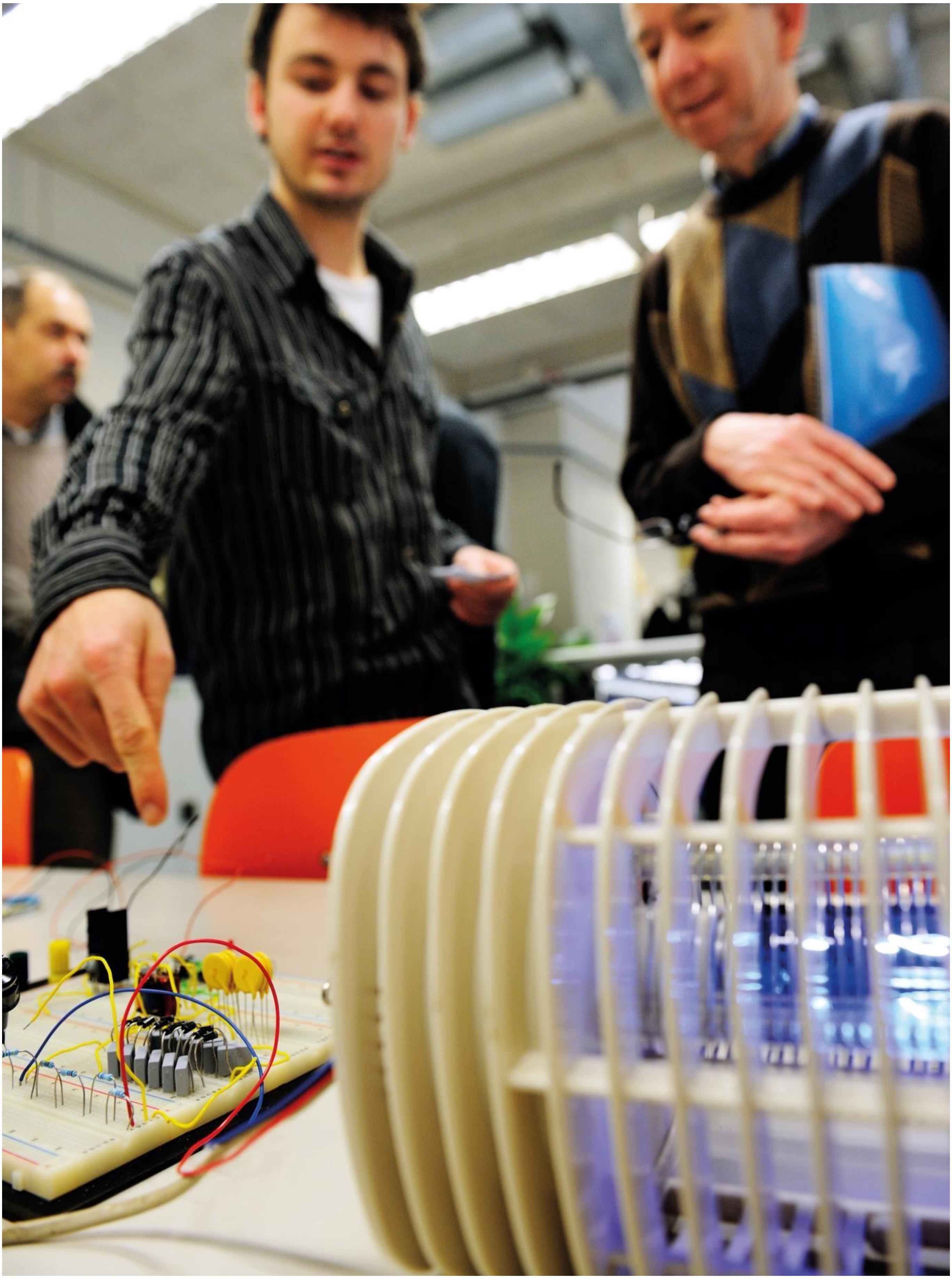
3. Competence assessment of professional role fulfillment occurs by expert teachers (tutors and subject teachers). The assessments are of summative kind.

4. Students acquire competences in the context of the professional situation, so in the curriculum with projects, internships and graduation. In addition, specific knowledge and skills are taught in modules with theory and practicals. This means that the student has shown to possess the required skills (level 1, 2 or 3) if all educational units of the related level are achieved.

Personal development

Each student is supervised by the same tutor (SLB) throughout the study. The SLB has, among others, the following key tasks:

- Confidential
- Personal coach
- Observe students' progress and if necessary provide feedback
- Establish propaedeutic study advise
- Assisting in making study choices such as domain, minor, type of engineer, etc. and preparing portfolio.
- Assisting in the preparation of study recommendations.



Fontys School of Engineering
Rachelsmolen 1
5612 MA Eindhoven
Building R1
Phone: 08850 77333
Email: engineeringeindhoven@fontys.nl

Appendix B TER table Electrical and Electronic Engineering

TER

TER

Electrical Engineering year 1
2019-2020
07 Juni 2019

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EE1	EEBAD1	Analog Design 1	4.00	EEBAD11P	Assignment	Duo	O-V	n/a	EEBAD1 = (EEBAD11T + EEBAD12T)/2 and EEBAD11T ≥ 5.5 and EEBAD12T ≥ 5.5 and EEBAD11P ≥ V and EEBAD12P ≥ V
				EEBAD11T	Written Exam	Individual	1,0-10,0	n/a	
				EEBAD12P	Assignment	Duo	O-V	n/a	
				EEBAD12T	Written Exam	Individual	1,0-10,0	n/a	
	EEBDD1	Digital Design 1	4.00	EEBDD11P	Assignment	Individual	O-V	n/a	EEBDD1 = (EEBDD11T + EEBDD12T)/2 and EEBDD11T ≥ 5.5 and EEBDD12T ≥ 5.5 and EEBDD11P ≥ V and EEBDD12P ≥ V
				EEBDD11T	Written Exam	Individual	1,0-10,0	n/a	
				EEBDD12P	Assignment	Individual	O-V	n/a	
				EEBDD12T	Written Exam	Individual	1,0-10,0	n/a	
	EEBMA1	Mathematics 1	5.00	EEBMA11T	Written Exam	Individual	1,0-10,0	n/a	EEBMA1 = (EEBMA11T + EEBMA12T)/2 and EEBMA11T ≥ 5.5 and EEBMA12T ≥ 5.5
				EEBMA12T	Written Exam	Individual	1,0-10,0	n/a	
				EEBCO11P	Assignment	Individual	O-V	n/a	
				EEBDUT11P	Written Exam	Individual	O-V	n/a	
				EEBGES11P	Assignment	Individual	O-V	n/a	
				EEBPROJ11	Assignment	Individual and Group	1,0-10,0	n/a	

	EEBPROJ11	Project 1-1	6.00	EEBSEN11P	Assignment	Group	O-V	n/a	EEBPROJ11 ≥ 5.5 and EEBCO11P ≥ V and EEBENG11P ≥ V and EEBGES11P ≥ V and EEBSEN11P ≥ V
	EEBPROJ12	Project 1-2	6.00	EEBCO12P	Assignment	Individual and Group	O-V	n/a	EEBPROJ12 ≥ 5.5 and EEBCO12P ≥ V and EEBGES12P ≥ V and EEBSEN12P ≥ V
				EEBGES12P	Assignment	Individual	O-V	n/a	
				EEBPROJ12	Assignment	Individual and Group	1,0-10,0	n/a	
				EEBSEN12P	Assignment	Individual	O-V	n/a	
	EEBSCO1	Study and Career Orientation 1	2.00	EEBSCO11P	Assignment	Individual	O-V	n/a	EEBSCO1 = V if EEBSCO11P ≥ V and EEBSCO12P ≥ V
				EEBSCO12P	Assignment	Individual	O-V	n/a	
	EEBSD1	Software Design 1	3.00	EEBSD11P	Assignment	Individual and Duo	O-V	n/a	EEBSD1 = (EEBSD11T + EEBSD12T)/2 and EEBSD11T ≥ 5.5 and EEBSD12T ≥ 5.5 and EEBSD11P ≥ V and EEBSD12P ≥ V
				EEBSD11T	Written Exam	Individual	1,0-10,0	n/a	
				EEBSD12P	Assignment	Individual and Duo	O-V	n/a	
				EEBSD12T	Written Exam	Individual	1,0-10,0	n/a	

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EE2	EEBAD2	Analog Design 2	4.00	EEBAD21P	Assignment	Duo	O-V	n/a	EEBAD2 = (EEBAD21T + EEBAD22T)/2 and EEBAD21T ≥ 5.5 and EEBAD22T ≥ 5.5 and EEBAD21P ≥ V and EEBAD22P ≥ V
				EEBAD21T	Written Exam	Individual	1,0-10,0	n/a	
				EEBAD22P	Assignment	Duo	O-V	n/a	
				EEBAD22T	Written Exam	Individual	1,0-10,0	n/a	
	EEBDD2	Digital Design 2	4.00	EEBDD21P	Assignment	Individual	O-V	n/a	EEBDD2 = (EEBDD21T + EEBDD22T)/2 and EEBDD21T ≥ 5.5 and EEBDD22T ≥ 5.5 and EEBDD21P ≥ V and EEBDD22P ≥ V
				EEBDD21T	Written Exam	Individual	1,0-10,0	n/a	
				EEBDD22P	Assignment	Individual	O-V	n/a	
				EEBDD22T	Written Exam	Individual	1,0-10,0	n/a	
				EEBMA21T	Written Exam	Individual	1,0-10,0	n/a	

	EEBMA2	Mathematics 2	5.00	EEBMA22T	Written Exam	Individual	1,0-10,0	n/a	EEBMA2 = (EEBMA21T + EEBMA22T)/2 and EEBMA21T ≥ 5.5 and EEBMA22T ≥ 5.5
	EEBMMS2	Measurements, Modelling and Simulation 2	5.00	EEBMMS21P	Assignment	Individual	O-V	n/a	EEBMMS2 = (EEBMMS21T + EEBMMS22P)/2 and EEBMMS21T ≥ 5.5 and EEBMMS22P ≥ 5.5 and EEBMMS21P ≥ V
				EEBMMS21T	Written Exam	Individual	1,0-10,0	n/a	
				EEBMMS22P	Assignment	Individual	1,0-10,0	n/a	
	EEBPROJ21	Project 2-1	4.00	EEBCO21P	Assignment	Individual and Group	O-V	n/a	EEBPROJ21 ≥ 5.5 and EEBCO21P ≥ V and EEBSEN21P ≥ V
				EEBPROJ21	Assignment	Individual and Group	1,0-10,0	n/a	
				EEBSEN21P	Assignment	Group	O-V	n/a	
	EEBPROJ22	Project 2-2	4.00	EEBCO22P	Assignment	Individual and Group	O-V	n/a	EEBPROJ22 ≥ 5.5 and EEBCO22P ≥ V and EEBSEN22P ≥ V
				EEBPROJ22	Assignment	Individual and Group	1,0-10,0	n/a	
				EEBSEN22P	Assignment	Group	O-V	n/a	
	EEBSCO2	Study and Career Orientation 2	1.00	EEBSCO21P	Assignment	Individual	O-V	n/a	EEBSCO2 = V if EEBSCO21P ≥ V and EEBSCO22P ≥ V
				EEBSCO22P	Assignment	Individual	O-V	n/a	
	EEBSD2	Software Design 2	3.00	EEBSD21P	Assignment	Individual and Duo	O-V	n/a	EEBSD2 = (EEBSD21T + EEBSD22T)/2 én EEBSD21T ≥ 5.5 én EEBSD22T ≥ 5.5 én EEBSD21P ≥ V én EEBSD22P ≥ V
				EEBSD21T	Written Exam	Individual	1,0-10,0	n/a	
				EEBSD22P	Assignment	Individual and Duo	O-V	n/a	
				EEBSD22T	Assignment	Individual and Duo	1,0-10,0	n/a	

TER

Electrical Engineering year 2
2019-2020
07 Juni 2019

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EE3	EEAAD3	Analog Design 3	4.00	EEAAD3P	Assignment	Individual and Duo	O-V	n/a	EEAAD3 = EEAAD3T and EEAAD3T ≥ 5.5 and EEAAD3P ≥ V
				EEAAD3T	Written Exam	Individual	1,0-10,0	n/a	
	EEACOM3	Communication 3	2.00	EEACOM3	Assignment	Individual	1,0-10,0	n/a	EEACOM3 ≥ 5.5
	EEACSA1	Career Supporting Activity 1	1.00	EEACSA1	Assignment	Individual	O-V	n/a	EEACSA1 ≥ V
	EEACT1	Control Theory 1	5.00	EEACT1P	Assignment	Individual	O-V	n/a	EEACT1 = EEACT1T and EEACT1T ≥ 5.5 and EEACT1P ≥ V
				EEACT1T	Written Exam	Individual	1,0-10,0	n/a	
	EEAES	Embedded Systems	5.00	EEAESP	Assignment	Individual and Duo	O-V	n/a	EEAES = EEAEST and EEAEST ≥ 5.5 and EEAESP ≥ V
				EEAEST	Written Exam	Individual	1,0-10,0	n/a	
	EEAFEC	Fields, Energy & Conversion	5.00	EEAFECP1	Assignment	Individual	O-V	n/a	EEAFEC = EEAFECT and EEAFECT ≥ 5.5 and EEAFECP1 ≥ V and EEAFECP2 ≥ V
				EEAFECP2	Assignment	Individual	O-V	n/a	
				EEAFECT	Written Exam	Individual	1,0-10,0	n/a	
	EEAPROJ4	Project 4	3.00	EEAPROJ4	Project	Individual and Group	1,0-10,0	n/a	EEAPROJ4 ≥ 5.5
	EEAPROJ5	Project 5	3.00	EEAPROJ5	Project	Individual and Group	1,0-10,0	n/a	EEAPROJ5 ≥ 5.5
	EEASEN3	System Engineering 3	2.00	EEASEN3	Assignment	Individual and Group	1,0-10,0	n/a	EEASEN3 ≥ 5.5

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EE4	EEACOM4	Communication 4	3.00	EEACOM4	Assignment	Individual	O-V	n/a	EEACOM4 ≥ V

	EEACSA2	Career Supporting Activity 2	1.00	EEACSA2	Assignment	Individual	O-V	n/a	EEACSA2 ≥ V
	EEADD3	Digital Design 3	5.00	EEADD3P	Assignment	Individual and Duo	O-V	n/a	EEADD3 = EEADD3T and EEADD3T ≥ 5.5 and EEADD3P ≥ V
				EEADD3T	Written Exam	Individual	1,0-10,0	n/a	
	EEAEMBC	Embedded Connectivity	5.00	EEAEMBCP	Assignment	Individual and Duo	O-V	n/a	EEAEMBC = EEAEMBCT and EEAEMBCT ≥ 5.5 and EEAEMBCP ≥ V and EEAEMBCPr ≥ V
				EEAEMBCPr	Project	Group	O-V	EEAEMBCP = V	
				EEAEMBCT	Written Exam	Individual	1,0-10,0	n/a	
	EEAPROJ6	Project 6	3.00	EEAPROJ6	Project	Individual and Group	1,0-10,0	n/a	EEAPROJ6 ≥ 5.5
	EEAPROJ7	Project 7	3.00	EEAPROJ7	Project	Individual and Group	1,0-10,0	n/a	EEAPROJ7 ≥ 5.5
	EEASP1	Signal Processing 1	4.00	EEASP1P2	Assignment	Individual	O-V	n/a	EEASP1 = EEASP1T and EEASP1T ≥ 5.5 and EEASP1P ≥ V
				EEASP1T	Written Exam	Individual	1,0-10,0	n/a	
	EEATEL1	Telecom 1	3.00	EEATEL1P	Assignment	Individual and Duo	O-V	n/a	EEATEL1 = EEATEL1T and EEATEL1T ≥ 5.5 and EEATEL1P ≥ V1
				EEATEL1T	Written Exam	Individual	1,0-10,0	n/a	
	EEBAD4	Analog Design 4	3.00	EEBAD4P	Assignment	Individual and Duo	O-V	n/a	EEBAD4 = EEBAD4T and EEBAD4T ≥ 5.5 and EEBAD4P ≥ V
				EEBAD4T	Written Exam	Individual	1,0-10,0	n/a	

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EE5	EESTAGE	Internship	30.00	Internship	Execution and report	Individual	1,0-10,0	See criteria table	All partial marks ≥ 5.5 No compensation

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EE7	EAACS	Advanced Control Systems	4.00	EAACS	Written Exam	Individual	1,0-10,0	n/a	EAACS ≥ 5.5
	EAAES	Advanced Embedded Systems	4.00	EAAESP	Assignment	Individual and Duo	O-V	n/a	EAAES = EAAEST and EAAEST ≥ 5.5 and EAAESP ≥ V
				EAAEST	Written Exam	Individual	1,0-10,0	n/a	
	EAAPE	Advanced Power Electronics	4.00	EAAPE	Written Exam	Individual	1,0-10,0	n/a	EAAPE ≥ 5.5
	EAATEL/IoT	Advanced Telecom / IoT	4.00	EAATEL	Written Exam	Individual	1,0-10,0	n/a	EAATEL/IoT ≥ 5.5
	EACSA7	Career Supporting Activity	2.00	EACSA7	Assignment	Individual	1,0-10,0	n/a	EACSA7 ≥ 5.5
	EADSD	Digital System Design	4.00	EADSDP	Assignment	Individual and Duo	O-V	n/a	EADSD = EADSDT and EADSDT ≥ 5.5 and EADSDP ≥ V
				EADSDT	Written Exam	Individual	1,0-10,0	n/a	
	EAGC7A	GLOW completion A	2.00	EAGC7A	Assignment	Group	1,0-10,0	Be Creative minor (GLOW project)	EAGC7A ≥ 5.5
	EAGC7B	GLOW completion B	2.00	EAGC7B	Assessment	Group	1,0-10,0	Be Creative minor (GLOW project)	EAGC7B ≥ 5.5
	EAMBSE	Model Based System Engineering	2.00	EAMBSEP	Assignment	Individual and Duo	O-V	n/a	EAMBSE = EAMBSET and EAMBSET ≥ 5.5 and EAMBSEP ≥ V
				EAMBSET	Written Exam	Individual	1,0-10,0	n/a	
	EAPRS7	Project S7	10.00	EAPRS7	Project	Individual	1,0-10,0	n/a	EAPRS7 ≥ 5.5
	EAST	Sensor Technology	4.00	EASTP	Assignment	Individual and Duo	O-V	n/a	EAST = EASTT and EASTT ≥ 5.5 and EASTP ≥ V
				EASTT	Written Exam	Individual	1,0-10,0	n/a	
	WABI	Business Innovation	4.00	WABIP	Assignment	Group	O-V	n/a	WABI = WABIT and WABIT ≥ 5.5 and WABIP ≥ V
				WABIT	Written Exam	Individual	1,0-10,0	n/a	

	WAPI	Product Innovation	4.00	WAPI	Written Exam	Individual	1,0-10,0	n/a	WAPI ≥ 5.5
EE8	EEAFSTU	Graduation internship	30.00	EEAFST	Execution, report and defence	Individual	1,0-10,0	S1-S6 finished; maximum of two S7 modules open	All final marks ≥ 5.5

Criteria to proceed to the next semesters.

	From S12 (P-fase)	From S3 (main phase)	From S4 (main phase)	From S5 (internship)	From S6 (minor)	From. S7 (specialisation)
To S12 (P-phase)	For S1 Entry requirements pre-education and after S1 automaticly to S2					
To S34 (main phase)	P-certificate (within 12 months after first entrance date)	After S3 automaticly to S4				
To S5 (internship)	Not possible	Not possible	P-certificate and at least 3 expo-projects finished and **if the internship is during autumn:** in S3 no more then 1 theory resit and all the practicals finished and in S4 all the modules done and did an exam for it and **if the internship is during spring:** in S3 all the modules done and did an exam for it and in S4 no more then 1 theory resit and all the practicals finished			
To S6 (minor)	P-certificate and **the following strongest advice:** at least 3 expo-projects finished and **if the minor is during autumn:** in S3 no more than 1 theory resit and all the practicals finished and in S4 all the modules done and did an exam for it and **if the minor is during spring:** in S3 all the modules done and did an exam for it and in S4 no more then 1 theory resit and all the practicals finished. Each minor can have specified its own additional demands, e.g. TUe-minor, Minor abroad etc., see information meetings, portal, kiesopmaat, etc..					
To S7 (specialisation)	Not possible	Not possible	P-certificate and no more than 1 theory module insufficient from S3 and S4 and all the practicals and all Expo-projects finished and you fullfilled the demands for the S7 modules for which you enrolled, see OER.			
To S8 (graduation)	Not possible	Not possible	Not possible	Not possible	Not possible	P-certificate and S3 up until S6 finished and no more than 2 theory resits for S7

If a student does not meet the criteria above, the decision is made by the placement meeting at the end of each semester, mandated by the Exam Committee. The decision will be based on the grades in Progress, a possible prior meeting between the student and the study counsellor (initiative lies with the student), a resonable study program for the remaining program and possible special circumstances.
If the student does not agree with the decission of the placement meeting, he/she can file an appeal to the Exam Committee from Electrical and Electronic Engineering.

Appendix C TER table Mechatronics

TER

Mechatronics year 1
2019-2020
07 Juni 2019

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EM1	MCACOM1A	Communication Skills 1A	1.00	MCACOM1A	Assignment	Individual and Group	O-V-G	n/a	≥ V
	MCAEES1	Electrical Engineering Skills 1	1.00	MCAEES1	Practical Assignment	Individual	O-V-G	n/a	≥ V
	MCAENL1	Engineering in the Netherlands 1	1.00	MCAENL1	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCAPDV1	Personal Development 1	1.00	MCAPDV1	Portfolio	Individual	O-V-G	n/a	≥ V
	MCAPEC1	Principles of Electronic Circuits 1	3.00	MCAPEC1P	Practical Assignment	Individual	O-V-G	n/a	MCAPEC1 = MCAPEC1T ≥ 5,5 and MCAPEC1P ≥ V
				MCAPEC1T	Written Exam	Individual	1,0-10,0	n/a	
	MCAPMA1	Production & Materials 1	2.00	MCAPMA1	Practical Assignment	Individual	O-V-G	n/a	≥ V
	MCAPRJ0	Project 0	3.00	MCAPRJ0	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCAPRJ1	Project 1	5.00	MCAPRJ1	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCBCOM1B	Communication Skills 1B	1.00	MCBCOM1B	Assignment	Individual and Group	O-V-G	n/a	≥ V
	MCBCPR1A	C Programming 1A	2.00	MCBCPR1AP	Practical Assignment	Individual	O-V-G	n/a	MCBCPR1A = MCBCPR1AT ≥ 5,5 and MCBCPR1AP ≥ V
				MCBCPR1AT	Written Exam	Individual	1,0-10,0	n/a	
	MCBCPR1B	C Programming 1B	1.00	MCBCPR1B	Assignment	Individual and Duo	O-V-G	n/a	≥ V

	MCBDRW1	Drawing 1	1.00	MCBDRW1	Practical Assignment	Individual	O-V-G	n/a	≥ V
	MCBMAT1A	Mathematics 1A	3.00	MCBMAT1A	Practical Assignment	Individual	1,0-10,0	n/a	≥ 5,5
	MCBMAT1B	Mathematics 1B	2.00	MCBMAT1B	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCBSTM1	Statics Mechanics 1	3.00	MCBSTM1A	Written Exam	Individual	1,0-10,0	n/a	MCBSTM1 = (MCBSTM1A + MCBSTM1B)/2 ≥ 5,5 and MCBSTM1A ≥ 5,5 and MCBSTM1B ≥ 5,5
				MCBSTM1B	Written Exam	Individual	1,0-10,0	n/a	

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EM2	MCAAEC2	Advanced Electronic Circuits 2	3.00	MCAAEC2P	Practical Assignment	Individual	O-V-G	n/a	MCAAEC2 = MCAAEC2T ≥ 5,5 and MCAAEC2P ≥ V
				MCAAEC2T	Written Exam	Individual	1,0-10,0	n/a	
	MCADFM2	Digital Fundamentals 2	3.00	MCADFM2P	Practical Assignment	Duo	O-V-G	n/a	MCADFM2 = MCADFM2T ≥ 5,5 and MCADFM2P ≥ V
				MCADFM2T	Written Exam	Individual	1,0-10,0	n/a	
	MCAMAS2	Modelling & Simulation 2	3.00	MCAMAS2P	Practical Assignment	Duo	O-V-G	n/a	MCAMAS2 = MCAMAS2T ≥ 5,5 and MCAMAS2P ≥ V
				MCAMAS2T	Written Exam	Individual	1,0-10,0	n/a	
	MCAMSK2	Measurement Skills 2	3.00	MCAMSK2P	Practical Assignment	Individual	O-V	n/a	MCAMSK2 = MCAMSK2T ≥ 5,5 and MCAMSK2P ≥ V
				MCAMSK2T	Written Exam	Individual	1,0-10,0	n/a	
	MCAPDV2	Personal Development 2	1.00	MCAPDV2	Portfolio	Individual	O-V-G	n/a	≥ V

	MCASYE2	Systems Engineering 2	1.00	MCASYE2	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCBCOM2	Communication Skills 2	1.00	MCBCOM2	Assignment	Individual and Group	O-V-G	n/a	≥ V
	MCBDMP2	Drawing & Machine Parts 2	2.00	MCBDMP2	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCBMAT2A	Mathematics 2A	3.00	MCBMAT2A	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCBMAT2B	Mathematics 2B	2.00	MCBMAT2B	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCBPRJ2	Project 2	3.00	MCBPRJ2	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCBPRJ3	Project 3	3.00	MCBPRJ3	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCBSOM2	Strengths of Materials 2	2.00	MCBSOM2	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EM3	MCAACT3	Actuators 3	3.00	MCAACT3	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCACOM3	Communication Skills 3	1.00	MCACOM3	Assignment	Individual and Group	O-V-G	n/a	≥ V
	MCADYN3A	Dynamics 3A	3.00	MCADYN3A	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCADYN3B	Dynamics 3B	3.00	MCADYN3B	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
				MCAESY3P	Assignment	Group	O-V-G	n/a	MCAESY3 = MCAESY3T ≥ 5,5 and MCAESY3P ≥ V

	MCAESY3	Embedded Systems 3	3.00	MCAESY3T	Written Exam	Individual	1,0-10,0	n/a	
	MCAICE3	Introduction Control Engineering 3	3.00	MCAICE3P	Practical Assignment	Duo	O-V-G	n/a	MCAICE3 = MCAICE3T ≥ 5,5 and MCAICE3P ≥ V
				MCAICE3T	Written Exam	Individueel	1,0-10,0	n/a	
	MCAPDV3	Personal Development 3	1.00	MCAPDV3	Opdracht	Individual	O-V-G	n/a	≥ V
	MCAPRJ4	Project 4	3.00	MCAPRJ4	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCAPRJ5	Project 5	3.00	MCAPRJ5	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCASYE3	Systems Engineering 3	1.00	MCASYE3	Assignment	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCBCSY3	Control Systems 3	3.00	MCBCSY3P	Assignment	Individual	O-V-G	n/a	MCBCSY3= MCBCSY3T ≥ 5,5 and MCBCSY3P ≥ V
				MCBCSY3T	Written Exam	Individual	1,0-10,0	n/a	
	MCBELS3	Electronics 3	3.00	MCBELS3T	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EM4	MCACEN4A	Control Engineering 4A	2.00	MCACEN4AP	Practical Assignment	Duo	O-V-G	n/a	MCACEN4A = MCACEN4AT ≥ 5,5 and MCACEN4AP ≥ V
				MCACEN4AT	Written Exam	Individual	1,0-10,0	n/a	
	MCACEN4B	Control Engineering 4B	3.00	MCACEN4BP	Practical Assignment	Duo	O-V-G	n/a	MCACEN4B = MCACEN4BT ≥ 5,5 and MCACEN4BP ≥ V
				MCACEN4BT	Written Exam	Individual	1,0-10,0	n/a	
	MCADEF4	Deformations 4	2.00	MCADEF4	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCADPR4	Design Principles 4	3.00	MCADPR4	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCAETS4	Ethics 4	1.00	MCAETS4	Assignment	Individual and Group	O-V-G	n/a	≥ V
	MCAMAT4	Mathematics 4	2.00	MCAMAT4	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5
	MCAOOP4	Object Oriented Programming 4	3.00	MCAOOP4	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCAPDV4	Personal Development 4	1.00	MCAPDV4	Assignment	Individual	O-V-G	n/a	≥ V
	MCAPRJ6	Project 6	3.00	MCAPRJ6	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCAPRJ7	Project 7	3.00	MCAPRJ7	Project	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCASYE4	Systems Engineering 4	1.00	MCASYE4	Assignment	Individual and Group	1,0-10,0	n/a	≥ 5,5
	MCBSDD4	Sequential Digital Design 4	3.00	MCBSDD4P	Assignment	Duo	O-V-G	n/a	MCBSDD4 = MCBSDD4T ≥ 5,5 and MCBSDD4P ≥ V
				MCBSDD4T	Written Exam	Individual	1,0-10,0	n/a	
	MCBSNS4	Sensors 4	3.00	MCBSNS4T	Written Exam	Individual	1,0-10,0	n/a	≥ 5,5

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EM5	MCASTAGE	Internship	30.00	MCASTAGE	Execution and report	Individual	1,0-10,0	SVC	≥ 5,5
EM6	n/a	Minor	30.00	n/a	n/a	Individual	O-V-G	SVC	≥ V

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EM7_AAS	MAEMC7	Electromagnetic Compatibility 7	2.00	MAEMC7P1	Practical Assignment	Individual and Duo	1,0-10,0	Or MAEMC7 or MAGC7B	MAEMC7 = (MAEMC7P1 + MAEMC7P2 + MAEMC7P3)/3 ≥ 5,5 MAEMC7P1 ≥ 5,5 MAEMC7P2 ≥ 5,5 MAEMC7P3 ≥ 5,5
				MAEMC7P2	Practical Assignment	Individual and Duo	1,0-10,0	Or MAEMC7 or MAGC7B	
				MAEMC7P3	Practical Assignment	Individual and Duo	1,0-10,0	Or MAEMC7 or MAGC7B	
	MAGC7A	GLOW completion A	2.00	MAGC7A	Assignment	Individual	1,0-10,0	Be Creative minor (GLOW project)	≥ 5,5
	MAGC7B	GLOW completion B	2.00	MAGC7B	Assignment	Individual	1,0-10,0	Be Creative minor (GLOW project)	≥ 5,5
	MAPRS7	Project Semester 7	10.00	MAPRS7	Project	Individual and Group	1,0-10,0	Internship	≥ 5,5
	MBAES7	Advanced Embedded Systems 7	4.00	MBAES7P	Practical Assignment	Duo	O-V-G	n/a	MBAES7 = MBAES7T ≥ 5,5 and MBAES7P ≥ V
				MBAES7T	Assignment	Individual	1,0-10,0	n/a	
	MBAIS7	Autonomous and Intelligent Systems 7	4.00	MBAIS7P1	Assignment	Group	1,0-10,0	n/a	MBAIS7 = (MBAIS7T + MBAIS7P1 + MBAIS7P2) /3 ≥ 5,5 MBAIS7T ≥ 5,5 MBAIS7P1 ≥ 5,5 MBAIS7P2 ≥ 5,5
				MBAIS7P2	Assignment	Group	1,0-10,0	n/a	
				MBAIS7T	Written Exam	Individual	1,0-10,0	n/a	
	MBDAM7	Design for Adaptive Manufacturing 7	4.00	MBDAM7P	Assignment	Group	1,0-10,0	n/a	MBDAM7 = (MCBDAM7P + MBDAM7T) ≥ 5,5 MBDAM7P ≥ 5,5 MBDAM7T ≥ 5,5
				MBDAM7T	Written Exam	Individual	1,0-10,0	n/a	
	MBMSY7	Mechatronic Systems 7	4.00	MBMSY7P	Assignment	Group	O-V-G	n/a	MBMSY7 = MBMSY7T ≥ 5,5 and MBMSY7P ≥ V
				MBMSY7T	Written Exam	Individual	1,0-10,0	n/a	
	MBSYE7	System Engineering 7	2.00	MBSYE7	Written Exam	Individual	1,0-10,0	Or MBSYE7 or MAGC7A	≥ 5,5

EM7_AMC	MAACE7	Applied Control Engineering 7	4.00	MAACE7P	Practical Assignment	Duo	O-V-G	n/a	MAACE7 = (MAACE7P + MAACE7T) ≥ 5,5 MAACE7P ≥ V MAACE7T ≥ 5,5
				MAACE7T	Written Exam	Individual	1,0-10,0	n/a	

	MADMD7	Dynamic Modelling & Design 7	4.00	MADMD7P	Practical Assignment	Duo	O-V-G	n/a	MADMD7 = (MADMD7P + MADMD7T) ≥ 5,5 MADMD7P ≥ V MADMD7T ≥ 5,5
				MADMD7T	Written Exam	Individual	1,0-10,0	n/a	
	MAEMC7	Electromagnetic Compatibility 7	2.00	MAEMC7P1	Practical Assignment	Individual and Duo	1,0-10,0	Or MAEMC7 or MAGC7B	MAEMC7 = (MAEMC7P1 + MAEMC7P2 + MAEMC7P3)/3 ≥ 5,5 MAEMC7P1 ≥ 5,5 MAEMC7P2 ≥ 5,5 MAEMC7P3 ≥ 5,5
				MAEMC7P2	Practical Assignment	Individual and Duo	1,0-10,0	Or MAEMC7 or MAGC7B	
				MAEMC7P3	Practical Assignment	Individual and Duo	1,0-10,0	Or MAEMC7 or MAGC7B	
	MAGC7A	GLOW completion A	2.00	MAGC7A	Assignment	Individual	1,0-10,0	Be Creative minor (GLOW project)	≥ 5,5
	MAGC7B	GLOW completion B	2.00	MAGC7B	Assignment	Individual	1,0-10,0	Be Creative minor (GLOW project)	≥ 5,5
	MAOBS7	Observers for State Space Systems 7	4.00	MAOBS7P	Practical Assignment	Duo	O-V-G	n/a	MAOBS7 = MAOBS7T ≥ 5,5 and MAOBS7P ≥ V
				MAOBS7T	Written Exam	Individual	1,0-10,0	n/a	
	MAPRS7	Project Semester 7	10.00	MAPRS7	Project	Individual and Group	1,0-10,0	Internship	≥ 5,5
	MBAES7	Advanced Embedded Systems 7	4.00	MBAES7P	Practical Assignment	Duo	O-V-G	n/a	MBAES7 = MBAES7T ≥ 5,5 and MBAES7P ≥ V
				MBAES7T	Assignment	Individual	1,0-10,0	n/a	
	MBSYE7	System Engineering 7	2.00	MBSYE7	Written Exam	Individual	1,0-10,0	Or MBSYE7 or MAGC7A	≥ 5,5
EM8	MCAAFSTU	Graduation	30.00	n/a	n/a	Individual	1,0-10,0	SVC	≥ 5,5

Appendix D TER table Mechanical Engineering

TER

Mechanical Engineering year 1
2019-2020
07 Juni 2019

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EW1	MEACAD	CAD & Drawings	3.00	MEACADP1	Practical Assignment	Individual	O-V	nvt	MEACADP1 = V MEACADP2 = V
				MEACADP2	Practical Assignment	Individual	O-V	nvt	
	MEAPERSD	Personal Development	1.00	MEAPERSD	Assignment	Individual	O-V	n/a	≥ V
	MEAPM1	Fundamentals of engineering materials and manufacturing	5.00	MEAPM1P1	Practical Assignment	Group	O-V	n/a	MEAPM1 = (MEAPM1T1 + MEAPM1T2) / 2 ≥ 5,5 whereby MEAPM1T1 and MEAPM1T2 ≥ 5,5 Grade for MEAPM1 will be assigned in case MEAPM1P1 has been concluded successfully.
				MEAPM1T1	Written Exam	Individual	1,0-10,0	n/a	
				MEAPM1T2	Written Exam	Individual	1,0-10,0	n/a	
	MEARGT	RGT support	1.00	MEARGT	Assignment	Individual and Group	O-V	n/a	MEARGT = V
	MEBEP1	Introduction Energy Theory	3.00	MEBEP1P	Practical Assignment	Group	O-V	n/a	MEBEP1 = (MEBEP1T1 + MEBEPT2) / 2 ≥ 5,5 whereby MEBEP1T1 and MEBEP1T2 ≥ 4,5. Grade for MEBEP1 will be assigned in case MEBEP1P has been concluded successfully.
				MEBEP1T1	Written Exam	Individual	1,0-10,0	n/a	
				MEBEP1T2	Written Exam	Individual	1,0-10,0	n/a	
	MEBPPR	Manufacturing Practical	2.00	MEBPPR1	Practical Assignment	Individual	O-V	n/a	Grade (V) for MEBPPR will be awarded in case both MEBPPR1 and MEBPPR2 have been concluded satisfactory.
				MEBPPR2	Practical Assignment	Individual	O-V	n/a	
	MEBWI1	Introduction math	5.00	MEBWI1T1	Written Exam	Individual	1,0-10,0	n/a	MEBWI1 = (MEBWI1T1 + MEBWI1T2) / 2 ≥ 5,5 whereby MEBWI1T1 and MEBWI1T2 ≥ 5,5
				MEBWI1T2	Written Exam	Individual	1,0-10,0	n/a	
				MECCM1T1	Written Exam	Individual	1,0-10,0	n/a	MECCM1 = (MECCM1T1 + MECCMT2)

	MECCM1	Statics	3.00	MECCM1T2	Written Exam	Individual	1,0-10,0	n/a	/ 2 ≥ 5,5 whereby MECCM1T1 ≥ 4,5 and MECCM1T2 ≥ 4,5
	MECPP2	Project & Professionalization 2	5.00	MECPP2P	Project	Individual and Group	1,0-10,0	n/a	Grade for MECPP2 is based on the MECPP2P grade and is rewarded(≥ 5,5) in case MECPP2T1 and MECPP2T2 are concluded satisfactory.
				MECPP2T1	Assignment	Individual	O-V	n/a	
				MECPP2T2	Practical Assignment	Individual	O-V	n/a	
	MEDPP1	Intro project Mechanical Eng	2.00	MEDPP1P	Project	Group	O-V	n/a	MEDPP1 = V

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EW2	MEACM2	Mechanics of Materials	5.00	MEACM2T1	Written Exam	Individual	1,0-10,0	n/a	MEACM2 = (MEACM2T1 + MEACM2T2) / 2 ≥ 5,5 whereby MEACM2T1 and MEACM2T2 ≥ 4,5
				MEACM2T2	Written Exam	Individual	1,0-10,0	n/a	
	MEAEP21	Fluid Mechanics	3.00	MEAEP21P	Practical Assignment	Group	O-V	n/a	MEAEP21 = MEAEP21T ≥ 5,5. Grade for MEAEP21 is awarded in case MEAEP21P is concluded satisfactory.
				MEAEP21T	Written Exam	Individual	1,0-10,0	n/a	
	MEAMR1	Electronics, Logic & Measurement	5.00	MEAMR1P1	Practical Assignment	Individual	1,0-10,0	n/a	MEAMR1 = (0,35 x MEAMR1T1 + 0,15 x MEAMR1P1 + 0,35 x MEAMR1T2 + 0,15 x MEAMR1P2) ≥ 5,5 whereby MEAMR1T1 and MEAMR1T2 ≥ 4,5 and MEAMR1P1 and MEAMR1P2 ≥ 5,5
				MEAMR1P2	Practical Assignment	Individual	1,0-10,0	n/a	
				MEAMR1T1	Written Exam	Individual	1,0-10,0	n/a	
				MEAMR1T2	Written Exam	Individual	1,0-10,0	n/a	
	MEAMS	Modelling and Simulation	4.00	MEAMS	MEAMS	Duo	1,0-10,0	n/a	MEAMS ≥ 5,5

	MEBPP3	Project & Professionalization 3	8.00	MEBPP3P1	Project	Individual and Group	1,0-10,0	n/a	MEBPP3 = (MEBPP3P1 + MEBPP3P2) / 2 Grade for MEBPP3 is awarded in case MEBPP3T1 and T2 exams are concluded satisfactory. MEBPP3P1 and MEBPP3P2 ≥ 4,5
				MEBPP3P2	Project	Individual and Group	1,0-10,0	n/a	
				MEBPP3T1	Assignment	Individual	O-V	n/a	
				MEBPP3T2	Assignment	Individual	O-V	n/a	
	MEBWI2	Advanced Math	5.00	MEBWI2T1	Written Exam	Individual	1,0-10,0	n/a	MEBWI2 = (MEBWI2T1 + MEBWI2T2) / 2 ≥ 5,5. MEBWI2T1 and MEBWI2T2 ≥ 5,5
				MEBWI2T2	Written Exam	Individual	1,0-10,0	n/a	

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EW3	MEACM3	Dynamics	3.00	MEACM3P1	Practical Assignment	Individual	O-V	nvt	Grade for MEACM3T1 will be awarded in case MEACM3P1 is concluded successfully. MEACM3T1 ≥ 5,5
				MEACM3T1	Written Exam	Individual	1,0-10,0	nvt	
	MEAEP22	Heat transfer	3.00	MEAEP22P	Practical Assignment	Group	O-V	MEBEP1	MEAEP22 = MEAEP22T ≥ 5,5. Grade for MEAEP22 will be awarded in case MEAEP22P is concluded successfully.
				MEAEP22T	Written Exam	Individual	1,0-10,0	MEBEP1	
	MEAPM2	Selection of engineering materials and heat treatment	5.00	MEAPM2P1	Practical Assignment	Group	O-V	n/a	MEAPM2 = (MEAPM2T1 + MEAPM2T2) / 2 ≥ 5,5 whereby MEAPM2T1 and MEAPM2T2 ≥ 4,5. Grade for MEAPM2 will be awarded in case both practicals are concluded successfully.
				MEAPM2P2	Practical Assignment	Group	O-V	n/a	
				MEAPM2T1	Written Exam	Individual	1,0-10,0	MEAPM1, MEACM1	
				MEAPM2T2	Written Exam	Individual	1,0-10,0	n/a	

	MEAWI4	Applied Mathematics	1.00	MEAWI4	Written Exam	Individual	1,0-10,0	MEAWI1, MEAWI2	MEAWI4 ≥ 5,5
	MEBDG1	Dynamic System Behaviour	4.00	MEBDG1T1	Assignment	Duo	1,0-10,0	MEAMS	MEBDG1T1 ≥ 5,5
	MEBMR2	Measurement & Control	5.00	MEBMR2P1	Practical Assignment	Duo	1,0-10,0	n/a	Final grade MEBMR2 = (0,35 x MEBMR2T1 + 0,35 x MEBMR2T2 + 0,15 x MEBMR2P1 + 0,15 x MEBMR2P2) ≥ 5,5 whereby MEBMR2T1 and MEAMR2T2 ≥ 4,5. MEBMR2P1 and MEBMR2P2 ≥ 5,5
				MEBMR2P2	Practical Assignment	Duo	1,0-10,0	n/a	
				MEBMR2T1	Written Exam	Individual	1,0-10,0	MEAMR1, MEAWI2, MEAMS	
				MEBMR2T2	Written Exam	Individual	1,0-10,0	n/a	
	MEBWI5	Lineair Algebra	1.00	MEBWI5	Written Exam	Individual	1,0-10,0	MEAWI1, MEAWI2	MEBWI5 ≥ 5,5
	MECPP4	Project & professionalization 4	8.00	MECPP4P1	Project	Individual and Group	1,0-10,0	n/a	MECPP4 = (MECPP4TP1 + MECPP4TP2) / 2 ≥ 5,5 Grade for MECPP4 is awarded in case MECPPT1 and T2 are concluded satisfactory.
				MECPP4P2	Project	Individual and Group	1,0-10,0	n/a	
				MECPP4T1	Assignment	Individual	O-V	n/a	
				MECPP4T2	Assignment	Individual	O-V	n/a	

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EW4	MEAEP3	Applied Thermodynamics	5.00	MEAEP3P	Practical Assignment	Group	O-V	MEBEP1	Grade MEAEP3 = (MEAEP3T1 + MEAEP3T2) / 2 ≥ 5,5 whereby MEAEP3T1 and MEAEP3T2 2 ≥ 4,5. Grade for MEAEP3 is awarded in case MEAEP3P is concluded successfully.
				MEAEP3T1	Written Exam	Individual	1,0-10,0	MEBEP1	
				MEAEP3T2	Written Exam	Individual	1,0-10,0	MEBEP1	
	MEAPM3	Forming, DoE and AM	5.00	MEAPM3P1	Practical Assignment	Duo	O-V	MEAPM1, MEAPM2, MEACM1	Grade MEAPM3 = (MEAPM3T1 + MEAPM3T2) / 2 ≥ 5,5 whereby MEAPM3T1 and MEAPM3T2 2 ≥ 4,5. Grade for MEAPM3 is awarded in case MEAEP3P1/P2 and P3 are concluded successfully.
				MEAPM3P2	Practical Assignment	Duo	O-V	MEAPM1, MEAPM2, MEACM1	
				MEAPM3P3	Practical Assignment	Duo	O-V	MEAPM1, MEAPM2, MEACM1	
				MEAPM3T1	Written Exam	Individual	1,0-10,0	MEAPM1, MEAPM2, MEACM1	
				MEAPM3T2	Written Exam	Individual	1,0-10,0	MEAPM1, MEAPM2, MEACM1	
	MEAWI3	Statistics	1.00	MEAWI3	Written Exam	Individual	1,0-10,0	n/a	MEAWI3 ≥ 5,5
	MEBCM4	Machine Elements	5.00	MEBCM4P1	Practical Assignment	Individual	O-V	MEACM2	MEBCM4T = (MEBCM4T1 + MEBCM4T2) / 2 ≥ 5,5 whereby MEBCM4T1 and MEBCM4T2 ≥ 5,5. Grade for MEBCM4 is awarded in case MEBCM4P1, P2 and P3 are concluded successfully.
				MEBCM4P2	Practical Assignment	Individual	O-V	MEACM2	
				MEBCM4P3	Practical Assignment	Duo	O-V	MEACM2	
				MEBCM4T1	Written Exam	Individual	1,0-10,0	MEACM2	
				MEBCM4T2	Written Exam	Individual	1,0-10,0	MEACM2	
	MEBHE1	Research Methodologies	5.00	MEBHE1P	Assignment	Individual	O-V	nvt	Cijfer HE1 wordt pas toegekend indien HE1P voldoende is HE1P ≥ 5,5
				MEBHE1T	Assignment	Individual and Duo	1,0-10,0	nvt	
				MEBPP5P1	Project	Individual and Group	1,0-10,0	n/a	EBPP5 = (MEBPP5P1 + MEBPP5P2) / 2 with MEBPP5P1 and MEBPP5P2 ≥ 5,5.

	MEBPP5	Project & professionalization 5	9.00	MEBPP5P2	Project	Individual and Group	1,0-10,0	n/a	Grade for MEBPP5 is awarded in case MEBPP5T1 and T2 are concluded satisfactory.
				MEBPP5T1	Assignment	Individual	O-V	n/a	
				MEBPP5T2	Assignment	Individual	O-V	n/a	

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EW5	MEIntern	Internship	30.00	MEIntern	Execution and report	Individual	1,0-10,0	See criteria table	All partial grades >= 5,5

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EW7_ET	WADFX	Design for Excellence	2.00	WADFX	Assignment	Group	1,0-10,0	n/a	WADFX ≥ 5,5
	WAEP12	Thermal Design	4.00	WAEP12T	Written Exam	Individual	1,0-10,0	WAEP22, WAEP3	WAEP12 ≥ 5,5
	WAEP13	Applied Energy Technology	4.00	WAEP13P	Assignment	Group	O-V	n/a	WAEP13P = V WAEP13T ≥ 5,5
				WAEP13T	Written Exam	Individual	1,0-10,0	n/a	
	WAPM13 / WADG2 / WABI	Selective module (period 2)	4.00	See module	See module	See module	See module	See module requirements	See module
	WAPRS7	Project S7	10.00	WAPRS7	Project	Individual and Group	1,0-10,0	n/a	WAPRS7 ≥ 5,5
	WASYE7	System Engineering	2.00	WASYE7	Written Exam	Individual	1,0-10,0	n/a	WASYE7 ≥ 5,5
	WBEP14	Sustainable Energy Systems	4.00	WBEP14T	Written Exam	Individual	1,0-10,0	WAEP22, WAEP3	WAEP14T ≥ 5,5
EW7_IE	WABI	Business Innovation	4.00	WABIP	Assignment	Group	O-V	n/a	WABIP = V WABIT ≥ 5,5
				WABIT	Written Exam	Individual	1,0-10,0	n/a	
	WACM5 / WACM10 / WAEP13 / WAEP14	Selective module 1 (period 1)	4.00	See module	See module	See module	See module	See module requirements	See module
	WADFX	Design for Excellence	2.00	WADFX	Assignment	Group	1,0-10,0	n/a	WADFX ≥ 5,5
	WADG2 / WAPM13 / WAEP12	Selective module 2 (period 2)	4.00	See module	See module	See module	O-V	See module requirements	See module
	WAPI	Product Innovation	4.00	WAPI	Written Exam	Individual	1,0-10,0	n/a	WAPI ≥ 5,5
	WAPRS7	Project S7	10.00	WAPRS7	Project	Individual and Group	1,0-10,0	n/a	WAPRS7 ≥ 5,5
	WASYE7	System Engineering	2.00	WASYE7	Written Exam	Individual	1,0-10,0	n/a	WASYE7 ≥ 5,5

semester	unit of study	name unit of study	credits	name of test	type of test	assessment type	assessment scale	prerequisites	norm/compensation
EW7_PE	WACM10	FEM	4.00	WACM10	Assignment	Individual	1,0-10,0	WACM2	WACM10 ≥ 5,5
	WACM5	Design Principles for precision	4.00	WACM5	Written Exam	Individual	1,0-10,0	WACM2	WACM5 ≥ 5,5
	WADFX	Design for Excellence	2.00	WADFX	Assignment	Group	1,0-10,0	n/a	WADFX ≥ 5,5
	WADG2	Dynamic Behaviour of Hightech System	4.00	WADG2T1	Assignment	Group	1,0-10,0	WAMR2, WADG1	WADG2 = (WADG2T1 + WADG2T2) / 2 ≥ 5,5 waarbij WADG2T1 en WADG2T2 ≥ 5,5 moeten zijn.
				WADG2T2	Written Exam	Individual	1,0-10,0	WAMR2, WADG1	
	WAPM13	Production & Materials for Precision	4.00	WAPM13	Written Exam	Individual	1,0-10,0	n/a	WAPM13 ≥ 5,5
	WAPRS7	Project S7	10.00	WAPRS7	Project	Individual and Group	1,0-10,0	n/a	WAPRS7 ≥ 5,5
	WASYE7	System Engineering	2.00	WASYE7	Written Exam	Individual	1,0-10,0	n/a	WASYE7 ≥ 5,5
EW8	MEGRAD	Graduation	30.00	MEGRAD	Execution, report and defence	Individual	1,0-10,0	See criteria table	Final grade = 0,3 x execution + 0,3 x report content + 0,2 x report style + 0,2 x presentation/defence. All partial grades ≥ 5,5

	Criteria w.r.t. S12 (Pfase)	Criteria w.r.t. S3 (main phase)	Criteria w.r.t. S4 (main phase)
To S12 (P-phase)	Entry requirements pre-education		
To S34 (main phase)	≥45 ECTS (within 12 months after first entrance date)		
To S5 (internship)	≥80 ECTS (Propedeutics not required but advised) and ≥25 ECTS in S3 in case of internship fall (S4 ≥25 ECTS in case S5-S6 are switched)		
To S6 (minor)	=60 ECTS		
To S7 (differentiation)	1) ≥80 ECTS (Propedeutics not required but advised), 2) S3 ≥ 25 ECTS, 3) entrance requirements of the S7 modules according to OER for the differentiation of choice have to be met. Note that participation and at least partially completion of S4 is mandatory		
To S8 (graduation)	= 60ECTS	= 60ECTS	

Ingangsniveau S7 te borgen via: 1) aantal credits in S3 (S3 is met name inhoudelijk bepalend) en OER

Criteria w.r.t. S5 (internship)	Criteria w.r.t. S6 (minor)	Criteria w.r.t. S7 (differentiation)
=30 EC or in repair		
= 30ECTS		Participated in S7 gevolgd and at least participated in all modules

n via specifieke ingangseisen modules conform

PROUD: **PR**ogramme **OU**tstanding **D**evelopment

March 2019

PROUD is the honours programme of Fontys Engineering. It is extra-curricular so only meant for those motivated students looking for more challenge in their education. It is meant specifically for getting more
Engineering Department . experiences and skills in the field of engineering and sharing these with their
fellow students and the

The following selection criteria are checked and applied in order to enter the PROUD programme as a member:

The student:

1. Has completed the first year with the propaedeutic certificate.
2. Has an approval by his/her study counsellor to join the programme.
3. Has proven to be well motivated for the program by means of a written motivation.
4. Passed the intake interview at the university.
5. Has been accepted for an internship/research project at one of the PROUD partners in the industry or at Fontys University / research.
6. Has defined a personal development plan that is approved of by the committee.

Main planning for PROUD
Semester 3: intakes and acceptance
Semester 4: start PROUD work
Semester 5: internship (when working for PROUD at a company preferable at that company)
Semester 6: PROUD work at company or Fontys and sharing his additional required knowledge and skills
Semester 7: PROUD work at company or Fontys, sharing his additional required knowledge and skills and finalizing the PROUD programme with the student's portfolio.

During the programme, no big delays in the regular programme are allowed and the PROUD student should show active behaviour and ownership in building his/her portfolio as mentioned below. PROUD Committees can decide to remove a PROUD student from the PROUD programme in case of study delay or not showing eagerness to the PROUD programme and/or community.

In order to finalize the PROUD programme with a certificate, we expect the PROUD student to deliver his/her final PROUD portfolio. In this document, the PROUD students show the final results of the required PROUD activities. The final PROUD portfolio shows the committees that the student has performed all the required activities, including a reflection on these items. Based on this evidence, the student will receive a PROUD honours certificate together with his Bachelor's degree

Appendix F1, Engineering Minor

Engineering Minor will be offered in spring 2020. Minorregulations will be made available in the Autumn of 2019.

Appendix F2 Minor Be Creative Minor regulations – 2019 - 2020

1. Name minor
Be Creative

2. English name
Be Creative

3. Content of minor
The Minor Be Creative focusses on the creative and entrepreneurial engineer. Within this minor you, as a student, are encouraged to create your own learning path, discover your talents and share your knowledge focusing in the WHY instead of the WHAT. The ultimate goal to achieve is that you, as part of a group of students, create a new product or concept, in a vast array of subjects. Noticeable regarding learning and educating:

- You are given a huge amount of freedom that makes you responsible for the end result;
- You as students set the pace and course;
- Lecturers are there for encouragement, advice and guidance;
- All within the new concept of learning: Connecting through Technology; we educate you to become the creative engineer of the future.

Rather than learning what the teachers say you have to learn, the minor is focused on what *you* want to learn and on *your* talent. Within this minor we want to focus on a different way of learning, in order to grab all the possible opportunities and excel in a way you did not expect. We want to create an environment in which learning is key instead of focusing on a forced result implied by the school system. We want you to have a great learning experience and reach your full potential in the next 20 weeks!

Resume for diploma supplement
The minor Be Creative focusses on the creative and entrepreneurial engineer. Within this minor students are encouraged to create their own learning path, discover their talents and share their knowledge. Students of the Be Creative minor learn in real-life situations where they, as part of a group of students, create a new product or concept in collaboration with various stakeholders.

4. Education components (see article 16 general section of the TER)
We believe that education should be focused on the learning goals and ambitions of a student. Understanding what the qualities of each individual student are and what the student wants to improve are of great importance to let this way of educating succeed. We believe that students should show a level of growth within their learning path and goals and are willing to share their knowledge and talents among other students. Our starting point within this minor consist out of main guidelines, that shares our vision on education.

1. <u>Focus on continuous learning, talent and feedback</u>

We believe that a continuous learning process is valuable for the student. It is of importance that students do not only learn a lot towards the end of a project or course, but throughout the whole project. Not only will the student learn more throughout the process, the student will also be aware of their strengths and weaknesses and know where they can improve early in the process. The continuous learning process is stimulated by feedback sessions held every three weeks. Next to that, the continuous learning process is also supported by their own individual learning goals. This intrinsic motivation of learning a specific skill stimulates the student even more. A motivated student sees education as a privilege not as an obligation.

We believe, every student should be able to choose their own learning path. By choosing your own learning path, you will be more motivated to reach your goals and grow in skills and personal development. Each student has to write a Personal Development Plan in which the student describes who he/she is and what he/she wants to learn throughout the minor. This means that the student should be able to self-reflect and be aware of the skillset and talents they have. Not only will they be able to discover their talent, but they might find a passion and will work from that.

Regular feedback and reflection moments are more valuable than just final grades, in this way we support talent development of every individual student. Through feedback the students will realize what their strengths and weaknesses are, and how they can develop and grow even further. Receiving feedback throughout the minor gives students the opportunity to adjust their way of working or attitude and show their qualities. Providing feedback to the students, will give the students the opportunity to strive for more and excel in what they didn't expect. As there is no focus on (final) grades, students will grow along the way throughout the project, rather than growing their focus learning peak in a final exam.

2. Learning in context

We believe the students are able to learn more when they are put into a real-life situation. As the projects are in collaboration with different stakeholders (companies, foundations, universities), the students experience a real-life situation with the stakeholders as client. Students need to plan and manage their own project, making them entrepreneurial and creative engineers. When the outcome of their project is successful enough, they will even realize it in the real world.

3. Sharing knowledge

We believe that every student has a certain set of knowledge and skills. By sharing this knowledge and skill set to the other students within their project, they are able to learn from others and grow in certain learning activities they did not expect. Students are stimulated to share their skills and their learning goals, to see and find where they match and can learn from each other. Because why would you learn something from scratch if someone else can teach you?

5. Enrolment in the education components

Does not apply

6. Overview of tests and registration for tests (see articles 18 and 22 general section of the TER)

As indicated above we focus on 3 main guidelines in the Be Creative minor. The evaluation criteria can be found in Appendix A.

1. Focus on continuous learning, talent and feedback is based on the final PDP report, reflection and 5 intermediate feedback presentations. These are graded by teachers and peers, based on 8 evaluation criteria.

2. Learning in context according project process and content based on final project report. These are graded by teachers, based on 12 evaluation criteria.

3. Sharing knowledge according course material based on given lectures or documentation. These are graded by the teachers and/or peers, based on 8 evaluation criteria.

The following requirements must be met in order to qualify for the final assessment:

1. The student has written and delivered their Personal Development Plan with specific goals in the first weeks;
2. The student has an overall positive chart, meaning that he showed an overall growth throughout the minor. An overall positive chart means:
   - The student has received *neutral* or *positive* in at least 3 out of 5 feedback sessions;
   - The student did not receive *negative* in the first two feedback sessions.
3. The student has been present at all of the feedback moments;
4. The student has shared knowledge and documented this in his portfolio;
5. The student has kept a blog about the project and personal progress;

6. The student has written a final document containing the following:
    - Personal Development Plan (this plan can be slightly different to the first version);
    - Collection of processed peer- and teacher feedback (as found in the feedback document);
    - Critical self-reflection on the whole project.
    - Group report about the project.
    - Portfolio (based on blog)
7. The student has made a video about their project (1 video per group);
8. Teacher should approve the final documents as mentioned in 6.

At the final assessment, there are three possible outcomes:

- Failure: Student scores less than 15 out of the 28 criteria on sufficient or higher, meaning that the student has failed the minor – no repairing phase is possible.
- Repair: Student scores less than 20 but more than 15 criteria on sufficient or higher. In this case the student is able to enter the repairing phase in agreement with the assessors. Together will be decided what is included to repair the score.
- Success: Student scores 20 or more out of the 28 criteria on sufficient or higher.

7. Passing the minor (see article 19 (3) general section of the TER)
In order to pass to minor the student needs to score at least 20 out of 28 evaluation criteria (Appendix A) sufficient or higher (based on a bullet scale). The bullet scale resembles the following grading:

O	O	O	O
Insufficient	Sufficient	Good	Excellent

The student will receive either a 30 EC or none (sufficient or insufficient).

8. Examination Board (see article 38 general section of the TER)
Exam committee Electrical Engineering
Jan v.d. Linde (chairman)
Henk Mandemaker (secretary)
Tekin Yilmaz (member)
Peter van Kollenburg (member)
Willem-Jan Verkerk (member)
Tilly van Berlo (secretarial assistant)

e-mail: examencommissie-engineering@fontys.nl

9. Validity
This information applies to the academic year 2019-2020.

10. Entry requirements minor
To enter the minor, students should have received a propaedeutic certificate or have permission of the examination committee of their own educational program. We also recommend students to gain experience in working project-based prior to the minor.

11. Not accessible for
Does not apply

No other requirements are to be met for participation in the minor or passing the minor than mentioned in these minor regulations.

Appendix A: Evaluation criteria

Learning objectives: 1. Focus on continuous learning, talent and feedback (Matrix 1) 2. Learning in context (Matrix 2) 3. Sharing knowledge (Matrix 3)	**Level on which the study objective is tested**			
	Reproduce	**Explain**	**Apply**	**Analyze, evaluate, create**
1. **Focus on continuous learning, talent and feedback** according PDP and focus on feedback. Based on final PDP report, reflection and 5 intermediate feedback presentations. (Graded by teachers and peers) *Minimal required products:* *1. written and approved PDP* *2. Overall positive chart* *3. Presence at all feedback sessions* *4. Blog* *5. Portfolio*				X
2. Learning in context *according project process and content based on final project report (graded by teachers) Minimal required products:* *1. Group project report* *2. Final presentation + interim presentations* *3. Video of the final prototype*			X	
3. Sharing knowledge *according course material based on shared knowledge and documentation (graded by teachers and/or peers) Minimal required products:* *1. Documentation of shared knowledge* *2. Evaluation by peers on shared knowledge* *3. Reflection on shared knowledge*				X

Assessment form 1: Focus on continuous learning, talent and feedback

Learning objectives:	**Level on which the study objective is tested**

1. Improvement of (technical) level 2. Approach 3. Working Attitude 4. Social Communicative Attitude 5. Professional Attitude 6. Giving & Receiving Feedback 7. Reflection 8. Presentation skills	**Feedback**	**Rating e.g.: O - O - ◉ - O**
1. Improvement of (technical) level The student creates and evaluates an improvement of their technical level throughout the minor. The student creates and evaluates an improvement of their soft skills throughout the minor.		O - O - O - O
2. Approach The student has been working efficiently and result oriented using SMART-goals as described in his Personal Development Plan. The student is able to analyze his social responsibility. The student makes sufficient use of the available approaches. The student shows initiative in developing himself. The student is willing to grasp the ability to learn more than expected.		O - O - O - O
3. Working Attitude The student shows flexible behavior. The student shows a positive working attitude towards his/her learning process.		O - O - O - O
4. Social Communicative Attitude The student communicates clear with other students and stakeholders, and is respected team member. The student is able to collaborate with other students and professionals involved.		O - O - O - O
5. Professional Attitude The student is able to create a planning and works according this planning, if necessary evaluate and adapt planning. The student is able to work independently and is disciplined. The student is able to challenge within his learning goals.		O - O - O - O
6. Giving & Receiving Feedback The student is able to give constructive feedback to team members. The student is able to cope with received feedback and improves himself according to the feedback received.		O - O - O - O
7. Reflection The student is able to reflect upon his (learning) activities. The student is able to evaluate himself and the way he works in order to improve.		O - O - O - O
8. Presentation Skills The student is able to present his reflection and learning goals. The student is able to present with a logical setup, correct structure and valid arguments. The student make use of audio-visual aids in a supporting way. The student is able to communicate well, both oral and non-oral, while presenting.		O - O - O - O

Assessment form 2: Learning in context

Learning objectives:	**Level on which the study objective is tested**

1. Technical Level 2. Quality 3. Integration Soft Skills & Hard Skills 4. The Problem Environment 5. The Problem Definition 6. Goal & Requirements 7. Approach Research Framework 8. Design/Research Methods 9. Results/Research Outcomes 10. Conclusions & Recommendation 11. Summarize 12. Readability of Report	**Feedback**	**Rating** **e.g.:** **0 - 0 - ◉ - 0**
1. Technical level The technical level of the student is sufficient enough to successfully execute the project, meaning creating a working prototype.		0 - 0 - 0 - 0
2. Quality The student shows quality within his performed work as a professional.		0 - 0 - 0 - 0
3. Integration Soft Skills & Hard Skills The student is able to apply his soft/hard skills within the project		0 - 0 - 0 - 0
4. The Problem Environment The student is able to clearly analyze the assignment. The student is able to apply the assignment in the proper context. The students is able to identify which stakeholders are professionally involved within the project.		0 - 0 - 0 - 0
5. The Problem Definition The student is able to extract a clear assignment from the problem description. The student is able to identify the opportunities, requirements and constraints from the problem description.		0 - 0 - 0 - 0
6. Goal The student is able to clearly define the goal of the project. The student is able to describe the goal of the project well including the boundary conditions (financial, time, etc.) and the goal has been concretely formulated SMART. The student creates a clear set of requirements he has to comply with.		0 - 0 - 0 - 0
7. Approach Research Framework The student is able to have a well-defined and clear design strategy. The student is able to define a logical and realistic design framework. The student is able to sufficiently motivate his design choices.		0 - 0 - 0 - 0
8. Design/Research Methods The student is able to apply a design method. The student is able to underpin for the choice of material and components. The student is able to take potential manufacturing and production methods into account		0 - 0 - 0 - 0
9. Results/Research Outcomes The student is able to adequately describe the final result. The student is able to match the final result with the requirements as stated in the assignment/goal.		0 - 0 - 0 - 0
10. Conclusions & Recommendation The student is able to reflect and evaluate on the realization of the project The student is able to make conclusions based on proper analytic consideration. The student is able to write relevant recommendations		0 - 0 - 0 - 0
11. Summarize The student is able to clearly describe his project in spoken and written communication by means of a summary.		0 - 0 - 0 - 0

12. Readability of Report The student is able to write a readable report for the target group (both client and teacher).		0 - 0 - 0 - 0

Assessment form 3: Sharing Knowledge

Learning objectives: **To share and broaden knowledge by giving class to other team members.** 1. Preparation 2. Knowledge level 3. Wide Interest Area 4. Quality 5. Learning Goals 6. Presentation & Communication 7. Questions 8. Documentation	**Level on which the study objective is tested**	
	Feedback	**Rating** **e.g.:** **0 - 0 - ◉ - 0**
1. Preparation The student is able to prepare appropriately for the sharing of knowledge and write a one page proposal		0 - 0 - 0 - 0
2. Knowledge Level The student has sufficient knowledge about the given subject at the moment of sharing his/her knowledge.		0 - 0 - 0 - 0
3. Wide Interest Area The student is able to explain and find relevance of general knowledge for the subject and generate a critical attitude towards this relevance.		0 - 0 - 0 - 0
4. Quality The student shows quality within his performed work as a professional.		0 - 0 - 0 - 0
5. Learning Goals The student is able to formulate the learning goals before the sharing of the knowledge.		0 - 0 - 0 - 0
6. Presentation & Communication The student is able to share knowledge with a logical setup and a correct structure. The student makes use of supporting materials (e.g. audio/visual.) The student is able to communicate well		0 - 0 - 0 - 0
7. Questions The student is able to understand the questions and/or feedback.		0 - 0 - 0 - 0
8. Documentation The student is able to document the shared knowledge so it is reproducible by others.		0 - 0 - 0 - 0

Appendix F3, Minor Adaptive Robotics Minor Adaptive Robotics: Minor regulations 2019-2020

1. Name minor: Adaptive Robotics (AR)

2. English name: Adaptive Robotics (AR)

3. Content of the minor

The minor Adaptive Robotics (AR) is an innovative minor both in terms of teaching form and the related examination method. The minor is talent-based and there is considerable focus on talent development among the individual students. The minor will be taught in English.

The minor consists of an intensive kick-off phase (lasting 2 weeks) followed by an orientation phase (of 3 weeks). During these phases, the students will be given assignments (individually and in groups) and will receive teaching in the following modules:

- *ROS for Engineers (Robot Operating System)*
- *Principles of Robotics*
- *Vision, Sensors & Perception*
- *Norms, Standards & Safety*
- *Hardware Abstraction & Embedded Hardware*

In each of these subject areas, examination will often be based on the work undertaken, including videos, posters, presentations, development of own teaching material, etc. On that basis, students will demonstrate that they have achieved their own in-depth learning targets.

The knowledge acquired will be applied and expanded within a multidisciplinary group project that will be undertaken during 14 weeks of the minor period. During these 14 weeks, students will spend 4 days a week on their project, and 1 day a week on acquiring in-depth knowledge in classes and workshops. Within specified frameworks, the students will have the opportunity to define their own project, in close consultation with relevant subject lecturers. These projects will be coached by lecturers (both in terms of process and technical content).

The minor offers a new educational model in which students will learn to recognize and use their own talents and in which teaching will be offered in the form of (multiday) workshops.

This minor is suitable for students with a technical background (specifically mechanical engineering, mechatronics, electronics, ICT and automotive) and students who demonstrate sufficient prior technical knowledge. This minor is ideal for students open to self-development, talent development, technology and who demonstrate a proactive attitude. Following this minor is not recommended for students who have not yet completed their company internship, or who wish to follow more ‘traditional’ education.

Within the minor AR, students will work on the following competences:

Analysis: Students themselves are capable of defining a project, formulating objectives and drawing up a schedule of requirements. The students will also learn to prepare safety requirements for the product in the module *Norms, standards & safety.*

Design: Students are capable of producing a design for their (robot) system within their project. Design will also be dealt with in the modules Hardware Abstraction & Embedded Hardware and ROS for Engineers (Robot Operating System).

Realization: The end product of the project is a working demonstrator. As part of a group, students will be able to build the demonstrator during the course of the project.

Control: Within the project, students will be able to evaluate whether their product complies with the requirements drawn up, and whether it complies with (existing) safety standards.

Management: Students learn to manage a project using the SCRUM method. Every two to three weeks, the students define the tasks in their project, and every two to three weeks deliver a subproduct. The results of each period (sprint) are presented in a project pitch for their fellow students and coaches.

Research: Supervised by coaches, students learn to study the material in depth from the modules that form part of the minor, together with other knowledge needed to implement their main project.

Professionalization: Supervised by coaches, students learn to define (and achieve) their own learning objectives, define their talents and reflect on those talents.

Diploma Supplement (Samenvatting voor diplomasupplement)

Participated as a Bachelor student (HBO) and has successfully accomplished the Adaptive Robotics Minor.

The holder of this Diploma Supplement has a high level of understanding of robotics and is able to design, develop and test robotics solutions that involved different robotics platforms as Autonomous Guided Vehicles (AGV's) and manipulators that can sense and autonomously and safely interact with the elements and humans in their environment. The holder has proven to have knowledge of: principles of robotics, hardware abstraction, embedded systems, system architecture, 2d and 3D vision, sensors and perception, norms and safety standards, programming with Python and Robot Operating Systems (ROS).

The holder of this Diploma Supplement is certified as a Roboticist and can contribute to the work force as: Roboticist, computer vision expert, system architect, Robot Operating Systems (ROS) expert and Python developer, System Engineer.

4. Overview of teaching activities in the minor (see article 12 general section of the Teaching and Examination Regulations)

The minor AR consists of four phases:

1. Kick-off (2 weeks): During the kick-off phase, students and lecturers are introduced to one another and to the content of the minor. Students are introduced to mechanics, motor control and motion control, 3D printing and the SCRUM method. The majority of this phase consists of a project (Gripper Case) carried out within a team of 2 to 3 people.
2. Orientation (3 weeks): In the orientation phase, students become conversant with all aspects (modules) of the minor AR. This is achieved on the basis of a series of workshops within the module. The most important (multiday) workshop is learning to work with ROS (Robot Operating System). This phase is concluded with a project in which students use ROS to control a real robot (Navigation case). During this phase, students also start investigating their talents and (in consultation) define the project they wish/intend to carry out in the project phase.
3. Project (14 weeks): In the project phase, students use their talents, knowledge and skills within a multidisciplinary team. During the project, they deepen their knowledge of the various modules/subject areas, with the assistance of their coach lectures and their self-defined learning objectives are tested. Students also develop their talents.
4. Conclusion (2 weeks): In the conclusion phase, students examine their final outstanding learning objectives, conclude the project work and present the project in a symposium.

The minor consists of the following modules:

ROS for Engineers
ROS (Robot Operating System) is a flexible framework for the development of robot software. It is a collection of tools, libraries, programming constructions and programming agreements. The most important use for ROS is the building of simple, platform-independent, complex robot applications.

Within the module ROS for Engineers, the basic principles and most commonly used tools and software components of ROS are discussed, to assist in the construction of various robot applications. This is using basic Object Oriented programming code in Python. This grants an insight into the possibilities of ROS. The programming of new robot software components is dealt with in the higher levels of this module.

Principles of Robotics
Robots are evolving rapidly from factory workhorses, limited physically to their work cells, into increasingly complex machines capable of implementing challenging tasks in a day-to-day environment. The aim of this module is to understand the basic concepts and algorithms on which the development of mobile robots and robot arms are based. The focus is on mobile travel and arm kinematics, observation of the environment, localisation and the production of a model of the environment (map) and path planning.

Vision, Sensors & Perception
A traditional robot in manufacturing industry is programmed to carry out a specific task, for example blindly picking up or setting down an object. The robot observes nothing of what is going on in its environment, and to protect factory workers, the robot is placed in a cage. An adaptive robot observes its environment with sensors such as cameras, laser range finders and with ultrasonic systems, and is required to act in a changing environment. This may be the observation of a factory worker or perceiving whether there is a cup of coffee on the draining board in a house. In this module, a series of camera and observation techniques are discussed (1D, 2D and 3D), together with a number of filter techniques, aimed at extracting relevant information from sensor data.

Norms, Standards & Safety
Machines and robots are required to comply with a series of regulations and standards. For industrial robots (fixed in their cell), these standards are already available (i.e. ISO10218-1 and ISO10218-2). For the next generation of robots (e.g. mobile platforms that move freely or robots that collaborate with other robots and people), these standards are currently being defined. In this module, students will be introduced to the world of standards, and will learn the basic principles of designing safe machines/robots both for industrial applications and for the next generation of robots.

Hardware Abstraction & Embedded Hardware
In this module, students will be taught how robot hardware, such as actuators and sensors can be combined using ROS and how abstraction from this hardware is possible, for ROS. Students learn which design choices they have to make in order to implement hardware abstraction for example for embedded systems or industrial buses. Students will learn about:
- different types of actuator
- motor controllers
- position sensors on wheels and joints
- image sensory systems and distance sensory systems
- the translation of sensor signals
- the translation of motor commands

The minor also includes a talent line. In this talent learning line, students are taught to understand and recognise their talents, by talent coaches. They also learn to recognise obstacles in their day-to-day life to making full use of their talents. A talent is different from a competence. A competence can for example be design. A talent could for example be ‘bridge builder’ or ‘pointing out someone’s errors’. Talents can support competences and can be deployed for acquiring competences, or implementing competences in a particular manner.

5. Registration for teaching activities in the minor

Not applicable.

6. Minor examination and registration for examinations (articles 18 and 22 general section of the Teaching and Examination Regulations)

Within the minor AR, five technical modules have been defined: Principles of Robotics, Vision & Perception, Norms, Standards & Safety, Hardware Abstraction & Embedded Hardware and ROS for Engineers (robot programming). Within each module, a student can achieve 4 levels. Learning objectives have been defined for each level, by a subject-competent lecturer (also the module owner). These learning objectives have been defined according to the Taxonomy of Bloom and range from understanding (level 1) through to application (level 2-3) and analysis/evaluation/ creation (level 4). The students are required to achieve at least level 1 for each module. Students can then opt to specialise further within the 5 modules. This further learning is based on a personal learning plan.

Learning objectives include:

Beginner: The student is able to explain such terms as SLAM, Kinematics, holonomic, omni wheel (Principles of Robotics)
Novice: The student is able to apply the key safety principles in system development (Safety)
Intermediate: The student is able to program a robot using software modules not discussed in class (ROS)
Expert: The student is able to combine information from a number of sensors to create an accurate 3D image of the environment (Vision)

Learning objectives for levels 1 and 2 are fixed for each module. For levels 3 and 4, students can attempt to achieve the learning objectives defined in advance, or select their own learning objectives (with a comparable degree of difficulty). These learning objectives must then be approved by the relevant module owner. A student cannot skip any levels; if a student wishes to achieve the learning objectives of level 4, he must first achieve the learning objectives of level 3.

For each technical module, examinations have been laid down for achieving level 1 and 2, that are the same for everyone. These learning objectives are examined for example via projects, video presentations, standard presentations and poster presentations. To achieve the learning objectives for levels 3 and 4, agreements must be reached concerning the form and submission method, with the module owners in question. Certain learning objectives can be examined according to specific work pieces undertaken by the student within his group project. Within the group project, each student has their own tasks. These are defined by the students themselves. Each student who design, developed and test of a robotics ROS compatible system can in this way demonstrate his learning objectives for example for level 3 or level 4 of the module ROS for engineers. The student is required to reach agreements on the demonstration requirements with the module owner. The module owner will determine whether the intended level has been achieved according to the work, the documentation and possibly additional explanation (e.g. viva) of the student.

Students can also opt to demonstrate learning objectives in the form of work that goes beyond the project. This can for example be achieved by producing a teaching module on a particular subject that relates to the learning objective and is approved by the module owner. An item of evidence must be presented with every examination.

The progress of the group projects is examined on the basis of two to three-weekly project pitches, in which students talk about what they have achieved and describe their next steps.

Talent education is concluded with a poster and video presentation in which the student demonstrates those areas in which he has achieved personal growth within this minor (which talents he has learned to recognise and how he has made use of those talents within the project).

There are no fixed intervals/moments for students, at which they ‘complete’ their subjects. In other words, the level can be determined at any moment the student and lecturer consider suitable (this will facilitate greater flexibility in the learning process). It does however mean that any retakes (of opportunities to demonstrate a level achieved) must always take place during the course of the minor, in consultation with the relevant lecturer(s).

7. Concluding the minor (see article 19, lid 3 general section Teaching and Examination Regulations)
If a student passes a level (learning objectives) within a module, points will be awarded. If the student has reached beginner level for all modules, he will be awarded 5 points. At the end of the minor, the student must have scored at least 20 points. He or she is therefore required to achieve a number of

new learning objectives, and specialise in a number of modules. For each level achieved, the student will be awarded 2 additional points. For example:

Field	Points
ROS (for Engineers)	3
Principles of Robotics	5
Vision sensors and perception	7
Norms, standards & safety	3
Hardware abstraction & embedded hardware	3
Gripper Challenge	1.5
Total	22.5

In the Kick-off phase, students participate in groups of 2 or 3 members in the Gripper case, if they meet the minimum requirements stablished for the competition, they are awarded 1.5 points.

In the orientation phase, students participate in the navigation case, if they meet the minimum requirements for the competition they are awarded 1.5 points.

In addition to individual learning objectives and to the gripper and navigation case, students must also successfully complete their group project. This is evaluated according to the following elements:

- is the technical level of the finished product sufficient
- is the work attitude within the group sufficient
- are the project results sufficiently described (technical reporting of the entire project)

These requirements are assessed by the group tutor. The specific criteria are announced to the students at the start of the minor.

Talent development is subject (among others) to the following specific learning objectives:

1. You are able to explain how talent influences your work in a project team

2. You are able to explain how you intend to use the knowledge and experience of the talent in applying for a suitable job.

You are able to explain clearly what you unique personal professional development you have undergone.

The minor will conclude with an overall assessment, and no ECs will be allocated for each individual module.

8. Board of Examiners (article 38 general section Teaching and Examination Regulations) Fontys School of Engineering acts as secretary for this minor. As a result, the Board of Examiners of the Fontys School of Engineering will determine whether the student has passed the minor and ensures that the student receives a certificate. The Board of Examiners is composed as follows:

Chair: Jan van der Linde
Secretary: Edgar v.d. Laak
Members: Wim Broekman, Fieke Geurts

The Board of Examiners can be contacted by e-mail (examencommissie-eng-aut@fontys.nl) for information about additional facilities and examination of the minor.

9. Validity
This information is valid for academic year 2019-2020.

Explanatory notes: interim changes to a minor are possible on condition they are clearly communicated to the students, and included in the minor regulations.

10. Admission requirements minor
To be able to participate in this minor, the student must have completed the foundation course phase and S3 and S4, or have received permission from the Board of Examiners of his study programme, to participate in the minor.

Furthermore, this minor is only open to students of a technical study programme in higher professional education (Engineering or ICT) and students who demonstrate a technical background at higher professional education level.
There are 32 places available in the minor. Therefore students are required to write a motivation letter of maximally 2 pages explaining why he/she wants to participate in this minor and his/her educational and professional technical background and affinity with robotics. Based on this motivation letter the participants of this minor will be selected. Students will receive notice the latest 1 month prior to the start of the minor.

11. Not open to:
Students with no demonstrable technical background at higher professional education level.

No other requirements for participation and completion of the minor are imposed on students, than those laid down in the minor regulations presented in this document.

APPENDIX H4 MINOR SPDAM Minor SPDAM Regulations - 2019-2020

1. Name minor:

Smart Product Development Additive Manufacturing (SPDAM)

2. English name:

Smart Product Development Additive Manufacturing (SPDAM)

3. Content of minor

The minor Smart Product Development with Additive Manufacturing (SPDAM), an in-depth technical minor on 3D-printing. You will achieve competences –a combination of practical and theoretical knowledge, practical and cognitive skills, and behavior and values– enabling you to work in an additive manufacturing (AM) environment. The program learning goals are stated below:

- You will learn about the possibilities and limitations of AM-machines, and how to help companies (e.g. high tech industry, medical) to implement this new production technology. You will attain skills in the engineering design process:
  - systematic approach from function to solution, o in the field of mechanical, thermal, and flow product structures.
- You will be able to use specialized software packages for drawing, modelling, analysis, and simulation.
- You will learn about selecting materials and production technologies, and gain skills to operate different types of AM-machines and associated equipment:
  - properties of a machine o material science tests
  - occupational health and safety issues

Unit	Contents
Theory module	**Design for Additive Manufacturing (DFAM)** Design guidelines, Topology optimization, Economic aspects, Killer application identification (practice).
Practicals module	**Practical Skills for Additive Manufacturing (PSAM)** Hands-on experience in the lab with AM-equipment, Reverse engineering, Production preparation, Post processing, Testing materials and printed parts, Using specialized software (e.g. Materialise Magics), Occupational health and safety issues.
Theory module	**Production technology and Materials (PM11)** Properties of materials for AM, Heat treatment, Testing of materials. Conventional (lathes, milling, welding) versus additive processing, Different types of AM-machines, Support structures, Production flow.
Computer Module	**Stress analysis and Optimization (CM11)** Theoretical background and practical skills in finite element method. Modelling, analyzing, and optimizing mechanical stress by topology optimization in a product using professional software.
Computer Module	**Heat and Flow analysis (EP11)** Principles of heat and flow transfer. Theoretical background and practical skills in finite element method. Modelling and analyzing heat and/or flow, e.g. in a heat exchanger or injection mold, using professional software.
Project	**Integrated Product Development (IPDAM)** Project assignment from different companies (High Tech Systems, Medical, or General), which involves analyzing, designing, building and testing a product in which AM can deliver a superior solution.

3.1 Summary for diploma supplement

The minor Smart Product Development with Additive Manufacturing (SPDAM) is an in-depth technical minor on 3D-printing where learned a combination of practical and theoretical knowledge, practical and cognitive skills, and behavior and values– enabling to work in an additive manufacturing (AM) environment. The possibilities and limitations of AM(-machines), and how to help companies (e.g. high tech industry, medical) to implement this new production technology.

4. Education components (see article 16 general section of the TER)

Code	Title / Examination	Study load and contact hours
DFAM DFAM1 DFAM2	**Design for Additive Manufacturing** Written exam (individual) 100 minutes Re-designed part, presentation, report	**DFAM: 112 hours total = 5.6 hr/week**
PSAM PSAM1 PSAM2	**Practical Skills for Additive Manufacturing** Practical assignments and participation Practical assignments and participation	**PSAM: 112 hours total = 5.6 hr/week**
PM11 PM11T1 PM11T2	**Production technology and Materials** Written exam (individual) 100 minutes Written exam (individual) 100 minutes	**PM11: 112 hours total = 5.6 hr/week**
CM11 CM11P1 CM11P2	**Stress analysis and Optimization** Practical assignments Project + written exam (individual) 100 minutes	**CM11: 112 hours total = 5.6 hr/week**
EP11 EP11P1 EP11P2 EP11P3	**Heat and Flow analysis** Practical assignment heat Practical assignment flow Project	**EP11: 112 hours total = 5.6 hr/week**
IPDAM	**Project Integrated Product Development with Additive Manufacturing**	**IPDAM: 280 hours total = 14 hr/week**

5. Enrolment in the education components

Does not apply n.v.t.

6. Overview of tests and registration for tests (see articles 18 and 22 general section of the TER)

Code	Title / Examination	Grading
DFAM DFAM1 DFAM2	**Design for Additive Manufacturing** Written exam (individual) 100 minutes Re-designed part, presentation, report	**(DFAM1 + DFAM2) / 2 ≥ 55%** Grade: 10-100% Grade: 10-100%
PSAM PSAM1 PSAM2	**Practical Skills for Additive Manufacturing** Practical assignments and participation Practical assignments and participation	**(PSAM1 + PSAM2) / 2 ≥ 55%** Grade: 10-100% Grade: 10-100%
PM11 PM11T1 PM11T2	**Production technology and Materials** Written exam (individual) 100 minutes Written exam (individual) 100 minutes	**(PM11T1 + PM11T2) / 2 ≥ 55%** Grade: 10-100% Grade: 10-100%
CM11 CM11P1 CM11P2	**Stress analysis and Optimization** Practical assignments Project + written exam (individual) 100 minutes	**(CM11P1 + CM11P2) /2 ≥ 55%** Grade: 10-100% Grade: 10-100%
EP11 EP11P1 EP11P2 EP11P3	**Heat and Flow analysis** Practical assignment heat Practical assignment flow Project	**EP11P1 + EP11P2='sufficient',then EP11=EP11P3** Grade: insufficient / sufficient Grade: insufficient / sufficient Grade: 10-100%
IPDAM	**Project Integrated Product Development with Additive Manufacturing**	**≥ 55%**

- Written exams are provided in the English language.
- Enrolment for the exams (regular & resit) are automatically done by the organization for all students

7. Passing the minor (see article 19 (3) general section of the TER)

See table, section 6. All parts (DFAM, PSAM, PM11, CM11, EP11 and IPDAM) of the minor must be completed successfully. Sign up through Kies op Maat (https://www.kiesopmaat.nl), each module within be terminated whit a 5.5 or higher and the endscore will be:
((DFAM score/840x112) + (PSAM score/840x112) + (PM11 score /840x112) + (CM11 score/840x112) + (EP11 score /840x112) + (IPDAM score /840x280) = Endscore minor SPDAM

8. Examination Board (see article 38 general section of the TER)

Exam committee Mechanical Engineering E-mail: examencommissie-engineering@fontys.nl
Wim Broekman (chairman)
Karin van Krijl (secretary)
Jan van Schijndel (member)
Ton Gielen (member)
Esther Vinken (member)
Gisela Greijmans (secretarial assistant)

Centrale examencommissie

Email: examencommissie-eng-aut@fontys.nl
Chairman: Jan van der Linde

9. Validity

Deze informatie geldt voor het studiejaar 2019-2020

10. Entry requirements minor

Entry requirements based on an engineering/technical bachelor study, such as Mechanical engineering, Mechatronics, Automotive, or Applied Physics.
The student must be registered with one of the aforementioned studies and have completed the propedeuse.

11. Not accessible for

Students from programs other than **Mechanical engineering, Mechatronics, Automotive, or Applied Physics*** are excluded from participation.

*See section 10.

Appendix G

2019-2020 Academic year test registration procedure Fontys University of Applied Sciences Engineering

Test registration (standard and retakes)

- Full-time and part-time students must register for the standard tests or retakes.
- Registration is done at ProgRESS WWW (see manual on the portal for test registration).
- The registration period (course weeks 2 and 3) for the various test periods is included in the year roster of Fontys University of Applied Sciences Engineering. For a retake in course week 3, registration is only possible in course week 2.
- The registration period for the test of the 7^{th} semester is different from the above mentioned. Enrolment for these tests will be in course week 1 and 2.
- Students who haven't registered during the registration period but who do want to sit the test can still register up to, and including, one day before the test at a cost of €10 per test (to a maximum of €50 per test period).
  To do so, students should apply at the Operational Management Office.

  Registering on the day of the test is only possible by paying €20 at the Operational Management Office before the start of the test in question (to a maximum of €100 per test period).

  Payment must be made in cash at the Operational Management Office.

  It is not possible to sit a test without registering (via ProgRESS WWW, or upon payment after the registration period).
- Students who do not follow this registration procedure cannot sit the test.

2019-2020 Academic year test registration procedure - Fontys University of Applied Sciences Engineering

Appendix H Composition Examination Board per 1-1-2019

Central Examination Board

Chair	Jan van der Linde
Member	Fieke Geurts
Secretary	Wim Broekman
Member	Edgar van de Laak
External member	Vacancy
Administration	Esther van den Berg-Wolfs

Electrical Engineering

Chairman	Jan van der Linde
Secretary	Henk Mandemaker
Member	Peter van Kollenburg
Member	Tekin Yilmaz
Member	Willem-Jan Verkerk
Administration	Tilly van Berlo

Mechatronic Engineering:

Chairman	Fieke Geurts
Secretary	Chris Remmers
Member	Paul Goede
Member	Eric de Haas
Administration	Esther van den Berg-Wolfs

Mechanical Engineering:

Chairman	Wim Broekman
Secretary	Karin van Krijl
Member	Esther Vinken
Member	Ton Gielen
Member	Jan van Schijndel
Administration	Gisela Greijmans