3TU MSc in Embedded Systems

A critical engineering qualification for future decades
Embedded systems are hardware/software systems built into devices that are not necessarily “recognized” as computerized devices, but these systems do control the functionality and perceived quality of these devices. Some specific examples of embedded systems include: controllers for the ABS of a car or the operation of its engine; the automatic pilot of an aircraft; the chip set and software within a set-top box for a digital TV; a pacemaker; chips within telecare switching equipment; ambient devices; and control systems embedded in robots/mechatronic machines.

The importance of embedded systems is growing continuously. Exponentially increasing computing power (Moore’s law), ubiquitous connectivity and convergence of technology have resulted in hardware/software systems being embedded within everyday products and places. Already today 90% of computing devices are in Embedded Systems and not in PCs. The growth rate in embedded systems is more than 10% per annum and it is forecasted there will be over 40 billion devices (5 to 10 embedded devices per person on earth) worldwide by 2020. Today 20% of the value of each car is attributed to embedded electronics and this will increase to an average of 35-50% by 2020. Moreover, the value added to the final product by embedded software is often orders of magnitude higher than the cost of the embedded devices themselves.

The 3TU* MSc programme in embedded systems focuses on the design methodology of hardware and software user environments. It covers a wide spectrum of topics ranging from integrated circuit design, computer architecture, communication networks and real-time operating systems to software engineering and formal methods for embedded applications. As an essential component in the inexorable process of miniaturization, it is an exciting engineering science of the future.

A curriculum for the needs of tomorrow

The course duration is two years, with 60 EC (European Credits) per year. The course has the following overall three-part structure:

- Compulsory courses
- Elective courses
- Final project

Apart from the compulsory courses addressing all the basic sciences of embedded systems, each student has an individual programme. Homologation subjects are determined on the basis of entry level and students are free to choose elective subjects, internships and final projects within the guidelines of the Board of Examiners and the availability of places.

For specific information about the programmes at the three universities involved, please check the various websites:

- University of Twente: www.graduate.utwente.nl/esys
- Delft University of Technology: www.es.msc.tudelft.nl
- Eindhoven University of Technology: www.tue.nl/masterprograms/es

* The three leading universities of technology in the Netherlands - Delft University of Technology, Eindhoven University of Technology and the University of Twente - have joined forces in the 3TU* Federation (www.3tu.nl). This Federation explores innovations by combining and concentrating the strengths of all three universities in research, education and knowledge transfer.
One programme - three flavours

A largely identical programme can be followed at any of the three locations, with subtle differences related to local specializations. A non-exhaustive list of specializations is given below.

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<th>Location</th>
<th>Specialization</th>
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| University of Twente            | Dependable systems  
Embedded control systems  
Energy efficient systems  
Small embedded systems, e.g. ambient/pervasive systems  
Formal methods and tools       |
| Eindhoven University of Technology | Systems on chip  
Reliable embedded software design  
Architectures of embedded systems  
Formal analysis and design     |
| Delft University of Technology  | Embedded multiprocessors and reconfigurable systems  
Embedded software and dependable systems  
Low power embedded systems  
Wireless and mobile systems  
Intelligent mechatronic systems for aerospace applications |

Bearing in mind the current acute need for competent embedded systems experts due to growing system functionality and expanding application areas, career perspectives are excellent - in all areas of the manufacturing world, Europe, and particularly the Netherlands.

By embedding computer technology into all kinds of appliances, the functionality, usability, and reliability of these products is improved. It is, for instance, expected that 90% of all changes in car design in the coming years will be due to embedded systems. Some products, such as mobile phones, can only operate thanks to the high functionality and low energy requirements of embedded systems technology. Europe is home to some of the leading companies in automotive technology (DaimlerChrysler, BMW), avionics (Airbus), and consumer electronics (Philips, NXP) - industries in which embedded systems play important roles. The Netherlands has also acquired a strong position in embedded systems due to the presence of companies such as Philips, NXP, ASML, and Océ. The Universities of Delft, Twente and Eindhoven are all within driving range of many high tech SMEs used to cooperating with the major OEMs in the Netherlands using embedded systems in their equipment. Due to the presence of Philips and NXP, Eindhoven is one of the three centres of Embedded Systems Technology in Europe.

Programme graduates may expect exciting careers in numerous sectors of industry and academia ranging from management to design, research and development in technical departments. In our technologically developed society, commercial and governmental organisations are in constant need of people with a solid engineering education at the academic level, and this need will surely grow in the future. Because of system complexity, an increasing number of engineers are playing a crucial role in the advising on and selling of smart products and capital equipment. Naturally for those so predisposed there are also numerous careers awaiting embedded systems engineers in academia, where these skills are in high demand as well.
What is the 3TU.Federation?

The three leading universities of technology in the Netherlands - Delft University of Technology, Eindhoven University of Technology and the University of Twente - have joined forces in the 3TU.Federation (www.3tu.nl). This federation maximizes innovation by combining and concentrating the strengths of all three universities in research, education and knowledge transfer.

Within the framework of this cooperation, five joint MSc programmes have been developed that address key issues in engineering and society. These five MSc programmes are:

• Construction Management and Engineering
• Embedded Systems
• Science Education and Communication
• Sustainable Energy Technology
• Systems and Control

The main advantages for students

The 3TU MSc programmes have been developed as exclusive programmes of outstanding academic quality that enable you to study at three of the top universities in the Netherlands. These programmes focus on areas of innovation developed with state-of-the-art engineering expertise. You will have the opportunity to acquire qualifications and competences that are in high demand. Upon graduation you will have obtained an outstanding qualification profile. The 3TU masters combine excellent subject-based competences, research skills, the capacity for independent analysis and synthesis and an advanced capability to apply knowledge in practice.

The core programmes of the 3TU masters are largely identical and can be followed at any of the three locations. The admission procedures, teaching and examination regulations and academic calendars at all three universities have been carefully matched. You will benefit from the special strengths of the three universities by choosing a specialization at any of the three locations. You will be registered at the location of your choice, but you will automatically be co-registered at the other two locations to ensure access to the facilities of all three.

Universities of technology in the Netherlands

Delft University of Technology (TU Delft)

TU Delft (www.tudelft.nl) is an enterprising university at the forefront of technological development. The university trains the engineers of tomorrow by means of its fundamental and applied research and educational programmes. With its broad knowledge base, worldwide reputation and successful alumni, TU Delft contributes significantly to the development of responsible solutions to urgent societal problems worldwide. The university offers 16 BSc and 39 MSc programmes. With approximately 16,500 students, TU Delft is the nation’s largest university of technology with the most comprehensive range of engineering courses.

Eindhoven University of Technology (TU/e)

Eindhoven University of Technology (www.tue.nl) is a modern and relatively young university. Students find the atmosphere open, informal and friendly. As an ‘Eindhoven educated engineer’, you are able to carry out complex analyses and develop solutions based on your findings. You are a problem solver with the ability to design new products, processes and systems. This means you can offer the community new opportunities for sustainability, safety, health, welfare and prosperity. You can look forward to a varied, challenging, lucrative and socially relevant career.

Compared to other universities TU/e has the highest scientific output in cooperation with industry. This position confirms the unique and close cooperation in R&D with the high-tech business sector in Brainport Eindhoven and the rest of the Netherlands.

University of Twente (UT)

Integrating social and engineering sciences. Developing high tech, with a human touch. This is what the University of Twente is committed to. Through teaching and research at the highest level. And through the innovations brought to the market place by over 700 spin-off companies. We offer degree programmes in fields ranging from the behavioural and management sciences to engineering and natural sciences. Research spearheads include nanotechnology, biomedical technology, information technology, governance studies, and learning and cognition. The University of Twente is the only full-campus university in the Netherlands. 2,700 faculty and staff and 8,500 students and work and unwind in the beautiful green park grounds, supported by top facilities for research and teaching, as well as for sports and culture. It is home to events such as the world’s largest annual student think-tank Create Tomorrow. All on less than 2 hours drive from Amsterdam. UT offers 23 BSc programmes and 33 MSc programmes.
Admission requirements

Admission is jointly coordinated. The applicant is requested to apply only to the university of preference, because admission and registration at one university automatically means admission and co-registration at the other two.

Dutch students
Please check on www.3tudoorstroommatrix.nl whether your Bachelor’s degree is sufficient for admission, or whether you need to follow a pre-master programme.

International students
The minimum required English language competence level is IELTS 6.5 or equivalent. The applicant should possess a BSc degree from an accredited institute in Computer Science/Engineering, Electrical/Electronic Engineering or a related field. Check procedures at the three universities involved:
• Delft University of Technology: www.studyat.tudelft.nl
• Eindhoven University of Technology: www.tue.nl/masterprograms/es
• University of Twente: www.graduate.utwente.nl/esys/general

How to apply
See the procedures at the websites above.

More information?
For more information visit www.3tu.nl

Additional information can be obtained from:
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