Minor EE-Mi-218

Physics for Electronics

Electronic devices are generally not isolated, but rather they interact with the environment and are affected by it.

Understanding this enables us to improve devices, protect them from the environment and also let them interact safely with the environment. If you are interested in understanding the working of devices and their interactions with the surroundings, this is the minor for you.

Choose the Physics for Electronics minor!

"Electrical science has revealed to us the true nature of light, has provided us with innumerable appliances and instruments of precision, and has thereby vastly added to the exactness of our knowledge."

Nikola Tesla

Why Physics for Electronics?

Because electronics has to survive in, and often interact with the environment. In some cases, electronic systems are exposed to extreme environments. The development of transducers and reliable electronics would be impossible without the knowledge of the physics. Designing new devices relies on an understanding of the physics which makes them work. Without this knowledge improvements in electronic devices and transducers cannot be achieved.

What is the importance of Electrical Engineering, and of this minor in particular?

As traditional EE branches, such as communication and information processing, are continually expanding into other fields – such as medicine and pharmaceutics, robotics, infrastructure, etc. – EE is becoming pivotal in:

Transport: All forms of transport rely on electrical engineering for safety, efficiency and increasingly for power.

Sensors: Sensors, which convert a signal into an electrical output, play a role in all aspects of our lives, from automotive safety, hospital to your mobile phone. Smart cities are optimising traffic flow and monitoring air quality.

Energy: The future will see and increasing demand for electricity. This means a sustainable technological future – it will carry on requiring enormous engineering resources in the coming decades. Furthermore, improvements in storage and transmission are essential.

Medical: Modern medicine relies heavily on EE. From operating theatres to sensor patches, EE is making medical treatment safer and cheaper. Domestic electrical systems will allow the elderly to stay at home longer and safer.

Consumer products: All our household objects require electronics to be able to function.

The field of EE is broad and knowing how to apply EE will give you the much-needed edge in your engineering major. Register now for this minor at www.minors.tudelft.nl.

Antennas of the Square Kilometre Array (SKA) which will become the largest and most sensitive radio telescope. The design is based on the Dutch LOFAR telescope

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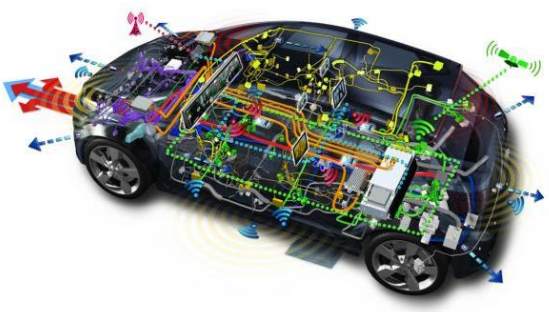
Challenge the future



Modern cars, besides using electronics for driving, have many hundreds of chips and sensors on board for autonomous driving, communication, and comfort

For whom is this minor?
This minor is of special interest to students in Electrical Engineering (EE) who want a deeper understanding of the role of physics in electronics. Mechanical (3M), Aerospace (AE) and Physics (AP) students can also greatly benefit from the same links.

If you see yourself engaged in multi-disciplinary work, then this is the minor for you. This minor will give you the tools to bring together different fields and link them to electronics.

The minor requires familiarity with basic mathematical instruments, such as vector analysis, solving differential equations, complex algebra and Fourier analysis. Self-tests are made available on the minor's site for assessing your readiness to follow the minor courses.

For more information, please contact the minor coordinators:
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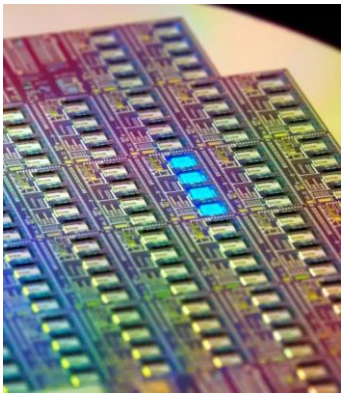
Programme

The minor consists of an entry point training, six courses (in two tracks, an EE track and a Non-EE track, with 5 common and 2 alternative courses), and a project.

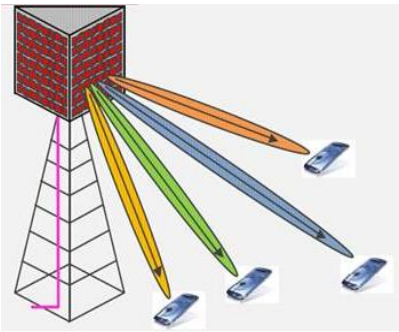
Courses

Introduction to Physics of Electronics (EE3345TU): An entry point training for harmonising the background of all participating students.

Linear Circuits (EE3355TU – Non-EE track course): This course will assist you in understanding and predicting the behaviour of linear electric circuits, with the goal of enabling you to make use in your major of the functionality offered by (relatively simple) linear circuits. The course will present the relevant theory, the accent being on self-study and problem solving.



Light emitting diodes assembled on a smart silicon interposer containing photodiodes, temperature sensors, and power electronics.



Future communications will use beam steering to enable power-efficient and high data rate communications

Transmission Lines (EE3360TU): This course will introduce you to one of the passive building blocks of high frequency circuits. These components will be analysed by deriving their intrinsic properties and examining their performance in various possible implementations (i.e., co-planar, micro-strip and stripline). During this course you will design and simulate various passive components using transmission lines and will test basic topologies in the lab.

Basics of Microfabrication (EE3365TU – EE track course): This course that will introduce you to the basic concepts related to the microfabrication of different semiconductor devices, ranging from integrated electronic components, like resistors and transistors, to micro-electromechanical systems used for sensors and actuators. To this end, the fundamental fabrication steps required to realise such devices will be discussed. Finally, an introduction to the packaging of electronic devices will be given, this being a crucial aspect in ensuring environmental resilience and/or interoperability.

Electronics for Imaging (EE3370TU): Imaging techniques are used in an extremely wide set of applications, both in the visible and non-visible range. This course describes the principles of basic imaging systems for electro-magnetic radiation detection: how the use of a mirror or lens of a certain size allows to make an image with a certain resolution, and how this image can be transferred into the digital domain. You will learn about the principles of both radio receivers and power detectors. The course will further extend into the imaging of mechanical waves, such as ultrasound.

Basics of Solid-State Physics (EE3375TU): This course will introduce you to the relationship the between material properties of semiconductors and the operation of two foremost electronic devices: p-n junctions (which form the basis for many devices, like for instance solar cells, light-emitting diodes, and photodiodes) and MOS devices (which dominate the design of many electrical circuits).

Introduction to Radio Astronomy (EE3350TU): Radio astronomy studies the universe using electromagnetic waves of frequencies from below 30 MHz up to 1 THz. Scientific targets are very broad, including the origin and fate of the Universe, galaxies, black holes, neutron stars, lifecycle of stars and planets, evolution of galaxies and galaxy clusters.

Transduction Effects (EE3380TU): This course focuses on the interaction between different signal domains. These include effects such as thermo-electric effects, batteries and many more. For each domain, the physics behind the interaction will be discussed. The course will also include a practical to illustrate these interactions.

Project

5G and AutoRadar (EE3385TU): The minor will demonstrate its practical applicability in a challenging project aiming at the design of a phase steering system for a 5G or automotive radar application. The project will be pursued in groups of 4-5 students.

For more information about the courses and the project, please refer to www.studyguide.tudelft.nl

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