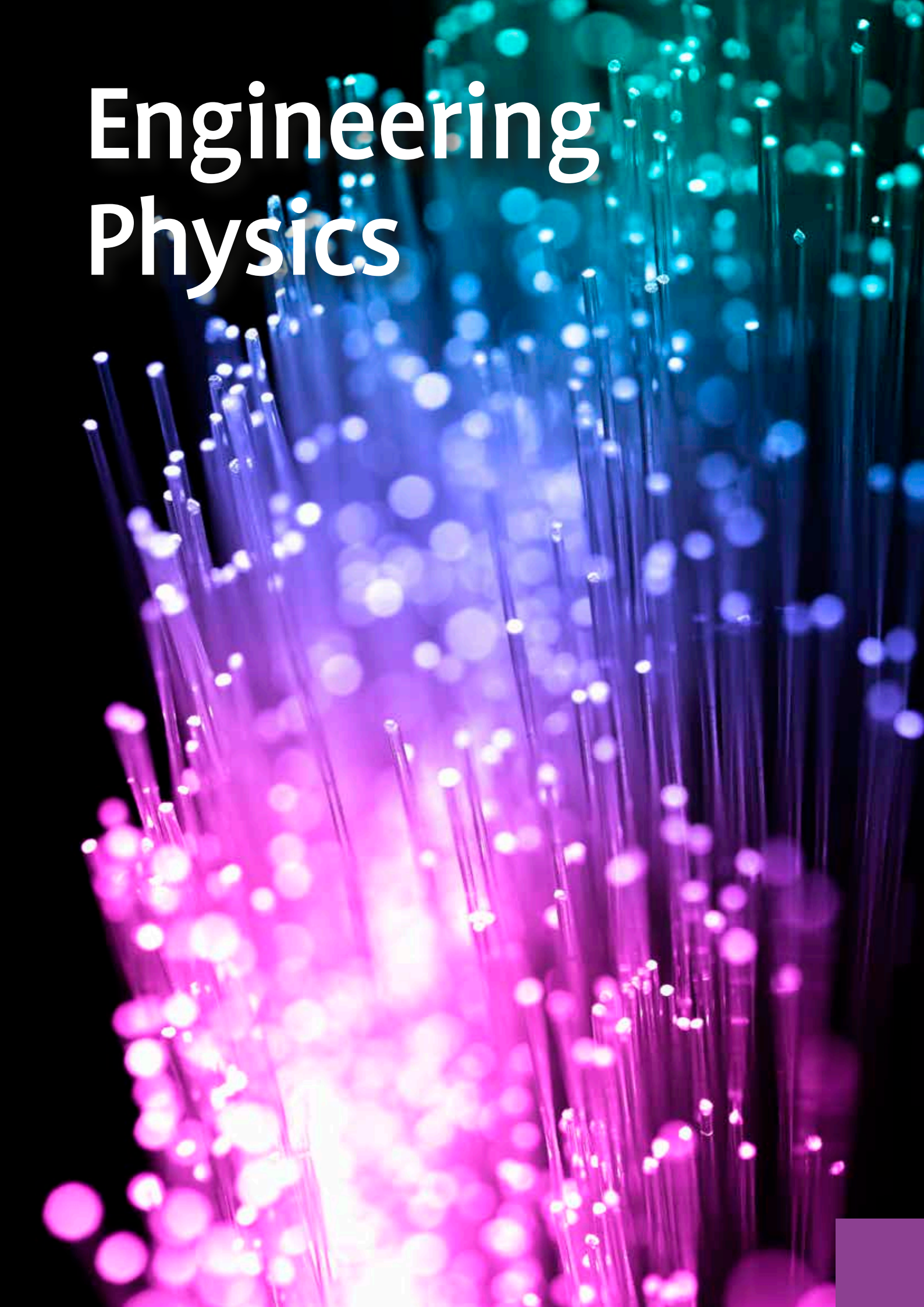
Engineering Physics



The higher professional course in ENGINEERING PHYSICS leads to a job as an applied physicist. Through research and experimentation, this graduate amasses knowledge and information that contribute to solutions for technological problems and provide opportunities for new technological developments.

The working methods of applied physicists are characterised by the fact that they operate at the interface of theory, modelling and experimentation. They try to establish a link between the results of these approaches, verifying theories by means of experimentation wherever possible. Engineering physics as a professional field is continuously developing. A thorough knowledge and understanding of the theory of the basic sub-fields within physics is needed in order to operate in the field as an applied physicist. An applied physicist has an understanding of key physical concepts and can apply them in practical situations. The most important skills required of an applied physicist consist of the ability to carry out research, make model-based calculations and to set up, prepare and conduct experiments. Physics-related issues arise in a variety of fields of activity, including sensor technology, photonics, nanotechnology, sustainable energy and medical technology.

Institutions that offer the programme

- Fontys University of Applied Sciences, Eindhoven
- The Hague University of Applied Sciences, Delft
- Saxion University of Applied Sciences, Enschede

National programme profile

	Competence							
	Research	Experimentation	Development	Management	Advice	Instruction	Leadership	Self-management
Minimum national attainment target adopted for the programme	**III**	**III**	**II**	**I**	**II**	**I**	**I**	**II**

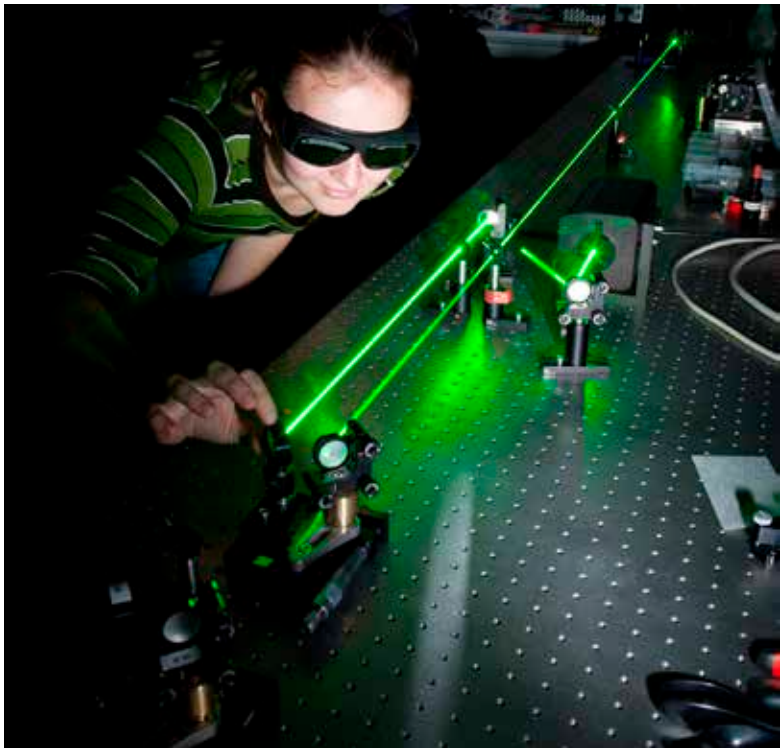


ILLUSTRATION OF PROFESSIONAL FIELD

Occupations, jobs and roles for graduates are mostly to be found in the following professional domains (for a full description of the professional domains, see Section 2). A few examples are given for each domain.

Research and development
- Engineering Physics researcher
- Project or development engineer
- Engineering Physics designer
- Photonician
- Metrologist

Engineering and manufacturing
- Metrologist/test engineer
- Product developer
- Process engineer
- Quality engineer

Commerce and customer service
- Medical physicist
- Service engineer
- Building physicist
- Radiation expert
- Audiologist
- Meteorologist
- Energy engineer
- Adviser/consultant

Engineering Physics

KNOWLEDGE

Physics
- Classical mechanics
- Electromagnetism
- Quantum mechanics
- Thermodynamics
- Waves and vibration
- Optics
- Properties of matter: elementary components and their interactions
- Atomic physics
- Nuclear and particle physics
- Acoustics
- Materials
- Fluid dynamics

Mathematics
- Calculus: elementary analysis and (linear) algebra
- Laplace and Fourier transforms
- Statistics and probability theory

Engineering
- Measurement and control technology
- Vacuum technology
- Energy engineering
- Electronics and signal processing
- Micro- and nanotechnology
- Laser technology
- Programming and data acquisition

SKILLS

- **General skills:** communication and collaboration, project-based work, systematic approach to problems
- **Skills relevant to the experimental approach:** building and managing test rigs and measurement systems, performing data acquisition for measurement system, programming, software including Labview, Excel, Matlab, programming languages
- **Skills relevant to the model-based approach:** using calculation and simulation software, designing a calculation or simulation program, programming, software including Matlab/ Simulink, Maple, Comsol Multiphysics, Ansys

The Body of Knowledge and Skills is a summary of graduates' basic knowledge and basic skills which has been prepared by the HBO-programmes in consultation with the professional field. These are obtained during the first two years of education.

TYPICAL TEXTBOOKS

- *Physics for Scientists and Engineers with Modern Physic,* D.C. Giancoli
- *Optics,* E. Hecht
- *Warmteleer voor technici,* A.J.M. van Kimmenaede
- *Regeltechniek voor HTO,* J. Schrage, H. van Daal
- *Applied Statistics and Probability for Engineers,* D. C. Montgomery, G.C. Runger
- *Polymeren, van keten tot kunststof,* A.K. van der Vegt, L.E. Govaert
- *Multiphysics Modeling Using COMSOL 4,* R.W. Pryor
- *OPTO-electronics: An introduction,* J. Wilson, J.F.B. Hawkes
- *Introductory Digital Signal Processing with Computer Applications,* P.A. Lynn, W. Fuerst
- *Fundamentals of Thermal Fluid Sciences,* Y.A. Cengel, R.H. Turner e.a.

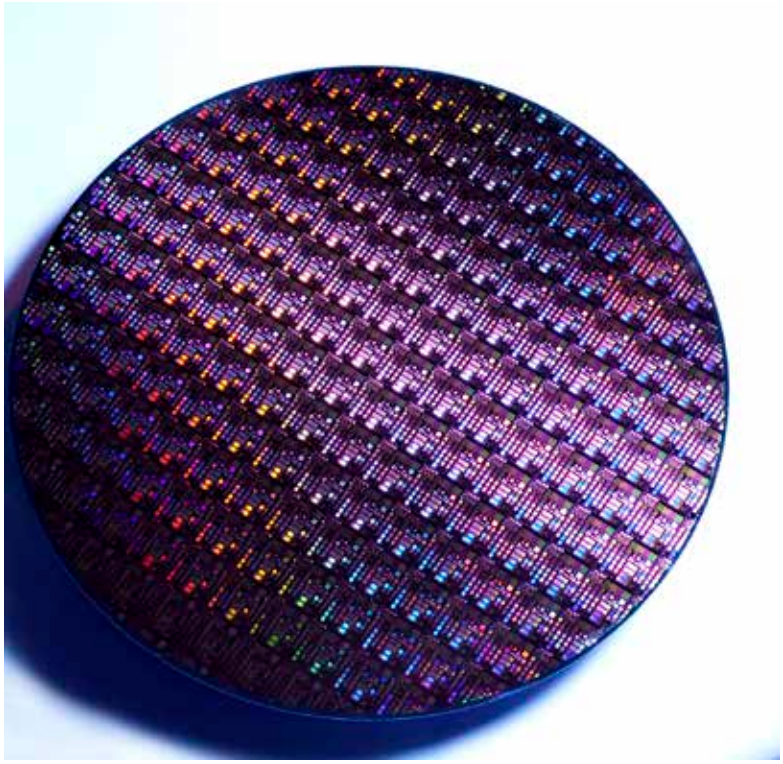
The list of typical textbooks serves as an illustration to give an impression of the level at which the subject is taught in the study programme.

Operational coordinator Hans Beckers:

‘The programme leaves you with technical baggage’

Name: Hans Beckers
Age: 41
Course of study: Engineering Physics
Place of employment: ASML Veldhoven
Job: Operational coordinator First Line Support NXE

‘With my pre-university diploma, I initially decided to study Engineering Physics at Eindhoven University of Technology. I had a wide range of subjects, the exact sciences suited me and I thought it would be good to focus on complex issues. Thinking out of the box – that appealed to me. However, after nine months I realised that too little time was devoted to practical work, common-or-garden physics. I then switched to the higher professional course in Engineering Physics and this seemed to fit in much better with my need for everyday physics. The application of technology in the world of medicine came up during the programme. That appealed to me, so I did an internship at Verbeeten Institute in Tilburg, a specialist hospital which provides top clinical care in the area of oncology and nuclear medicine. Choosing a specialisation wasn’t difficult: Engineering Physics.



I found my graduation project through my own network at Phillips, where I worked on “modelling for optical grooves”. My work has contributed to the fact that the DVD is as we know it today.

At AMSL we manufacture precision lithographic machines for the chip industry. In my current job, I am responsible for managing all failures in part of the production process of ASML’s most advanced machines. I make sure that the problems are solved to the internal or external customer’s satisfaction within the applicable time.

Commercial thinking

After spending a few years in “technology”, I am now more involved in guiding/coaching people, skills which I picked up through additional training. Another part of my job is to set up and standardise processes. This requires a more project-based approach. **Coordination | coaching | supervision** are things that I still use every day. At university, I feel, not enough attention was paid to working and thinking in a commercial way. You can come up with the most fantastic experiments or research, but they have to fit in with the customer’s time and cost frame.

The Engineering Physics course leaves you with a certain technical baggage, and from these foundations you start to specialise in specific subjects in industry. These are almost impossible to teach in the programme as it would be too specific. Structural thinking, analysing data and transferring knowledge are things to which attention was paid in the programme and which are useful in every organisation.

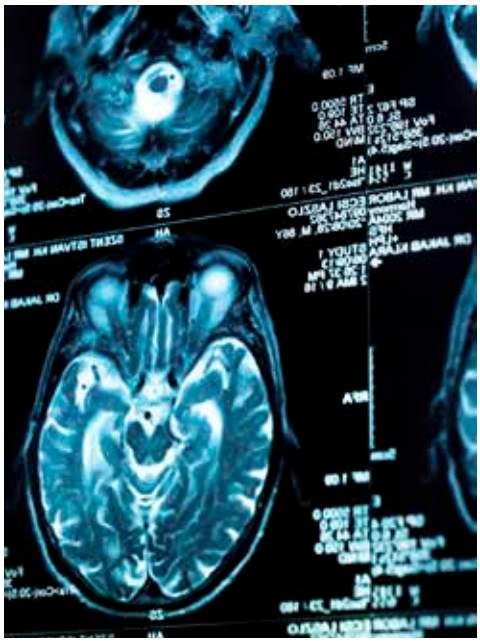
There are a lot of opportunities at ASML, it’s a large and diverse company. In the near future, the focus of my job will be shifting further towards the project-based delivery of processes, but my ambition still lies in the area of people management.’ ■

Clinical physics assistant Ruud Cools:

‘I was looking for answers to my questions’

‘When I got physics for the first time at secondary school, I discovered that I found it really interesting. But I still had questions and I therefore decided to choose a course of study that could possibly answer my questions. As my interests are so wide-ranging, a wide-ranging programme was a requirement. My physics teacher told me about the Engineering Physics programme and, after I had requested information, I quickly made my choice.

The questions that I had at secondary school were of course answered. Fortunately, they were replaced by more questions. As well as learning answers during my programme, I also learned techniques that enabled me to answer my questions myself. I enjoyed research so much that I tried to find a subject that I could research for my graduation. I had always been fascinated by light and therefore choose a subject within photonics (physics subject that focuses on interaction between photons and electrons).



I’m currently working in the radiotherapy department of the Erasmus MC, where cancer patients are treated with radiation. The quality of their treatment is very important and, as a clinical physics assistant, you have an essential role to play in this regard. The work is extremely varied. For example, we take measurements of the accelerators to ensure that they are still working properly. Sometimes, in order to take measurements, you have to develop new measurement and analysis methods. In addition, radiotherapy involves a great deal of innovation. These innovations first have to be checked and tested before we can use them in the clinic. Sometimes they are software solutions for obtaining the optimum radiation level and sometimes hardware solutions are also involved. My colleagues and I then have to devise tests to be able to guarantee that everything will work properly. There are also opportunities for working on research and innovation yourself. For example, I am currently creating a software application that will enable us to control the operation of the accelerator when it is administering a very complicated radiation treatment.

First learn physics

Every day in my work, I need the analysis technique and way of thinking I learned during my programme. However, you do acquire technical knowledge at school that you only need sporadically, if at all. My personal opinion is that as little emphasis as possible should be placed on competences other than the competence of development. That may sound harsh, but more than anything it is essential that students are trained to become good physicists. If someone is interested in making progress in other competences, they will pursue this interest themselves. In addition, working in industry is a very good apprenticeship for learning these “secondary” competencies, but you definitely have to have sufficient knowledge of the subject first. So learn physics first – the other competences will follow.’ ■

Name: Ruud Cools
Age: 26
Course of study: Engineering Physics
Place of employment: Erasmus MC
Job: Clinical physics assistant