Semiconductor Packaging University Program

Minor for bachelor students

CITC

Chip Integration
Technology Center

HAN_UNIVERSITY
OF APPLIED SCIENCES

Securing the future of the semiconductor industry in Europe

Together with HAN University of Applied Sciences, CITC developed the Semiconductor Packaging University Program. The program provides a connection between education and industry and as such contributes to the training and skills of people that align with industry needs. People who are in high demand – now and in the future. The program therefore represents an important step in securing the future of the semiconductor industry in Europe.

The program offers its participants training in all relevant aspects of chip packaging, both in theory and in practice. The theoretical part is provided by industry experts – in addition to CITC and HAN, the program was developed in collaboration with NXP, Nexperia, Ampleon, TU Delft and TNO. The practical assignments of the program are carried out on the premises of CITC and several semiconductor companies.

About CITC

Without advanced packaged and integrated chips, we can't live in smart houses, drive autonomous cars or communicate through 5G networks. Future societal challenges in energy, healthcare, mobility, agriculture and food mean that an increasing degree of intelligence must be built into products and services. As a key enabling technology, chips and their packages make this intelligence possible.

Chip Integration Technology Center (CITC) is a non-profit, joint innovation center specializing in heterogeneous integration and advanced chip technology. We bring leading innovations in chip integration and packaging technology to market in a selected and growing number of application areas. In this way, we provide solutions to societal challenges.

CITC has created an effective ecosystem in which companies, research and educational institutes work on bridging the gap between academics and industry. Together, we work on a new generation of packages providing smart, safe and rugged housing for chips. CITC's contribution to the ecosystem is to provide access to innovation, infrastructure and education.

> **"Theory and practice in the minor were very well balanced. What I particularly liked was that we worked on real problems. And it was a plus that the industry professionals all had their specialties, which gave me good insight into what people in the industry are doing."**
>
> Mahad Saeed,
> participant edition
> 2022-2023

> **"What I really liked was that we were actually allowed to work with the equipment. Wire bonding is a very challenging task, so it is good to have experienced this first-hand."**
>
> Diego Bouche,
> participant edition
> 2023-2024

CITC was founded in 2019 with strategic partners TNO and Delft University of Technology and is supported by local and regional governments. Located on Noviotech Campus Nijmegen, CITC is perfectly situated in the heart of the Dutch semiconductor industry.

Practical details

The Semiconductor Packaging University Program is offered as a differentiation minor to bachelor students who want to broaden their horizon into the field of semiconductor assembly and packaging. To be admitted to the program you must have completed two main modules in either Electrical Engineering, Applied Physics, Chemistry, Mechanical Engineering, Mechatronics, Automotive Engineering, or Industrial Engineering & Management. Part-time students not working in the semiconductor industry may be subject to an admission interview.

The program is a block minor, offered once a year in the first semester of the academic year. The study format is either full-time or part-time. After completion, you will receive a certificate to prove that the program is part of your bachelor's degree.

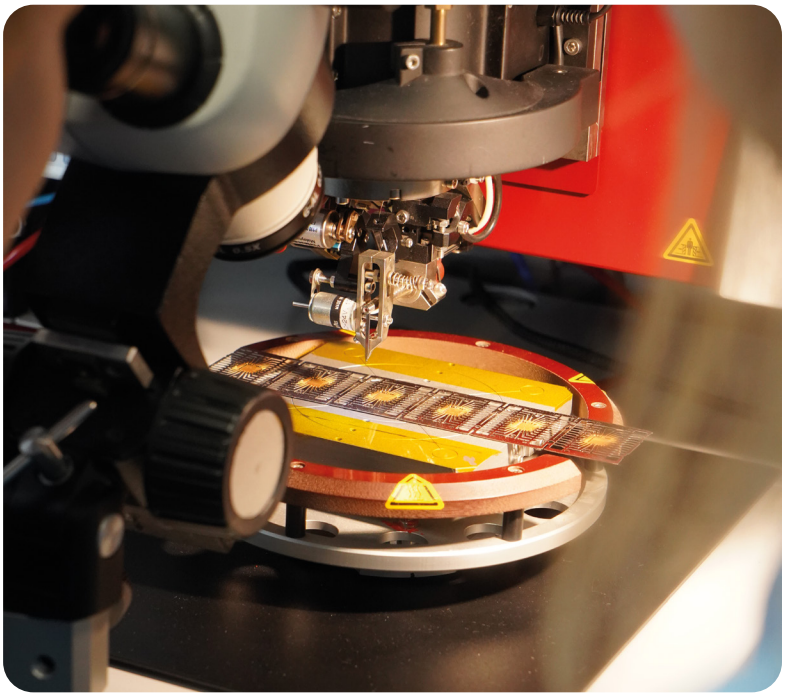
Location:	**theoretical part:** both online and on site at Noviotech Campus, Transistorweg 5T, Nijmegen, the Netherlands **practical part:** on site, location to be determined
Language:	English
Duration:	**theoretical part:** 9 weeks **practical part:** 10 weeks
Costs:	if the minor is part of your bachelor program in the Netherlands, there are no additional costs. If you are a bachelor student not based in the Netherlands, please contact your minor coordinator or career counsellor about possible compensation of the cost: € 4,750 excl. 21% VAT* + study material (approximately € 200)
Start date:	first week of new academic year - end of August/beginning of September

Are you interested in joining this course?
Please contact us at **info@citc.org** to receive the registration form.

If you are studying at HAN check out:
https://www.han.nl/opleidingen/cursus/semiconductor-packaging/

The minor is also available at **www.kiesopmaat.nl** for students based in the Netherlands.

**VAT is not applicable for private participants*



"During the program, I attended lectures by people working at semiconductor companies such as NXP, Sencio and Nexperia. They covered the entire semiconductor industry from the 1980s-2020s. It's probably still the tip of the iceberg, but I've learned so much about the backend industry".

Mudit Goyal,
participant edition
2021-2022

Program description

Participants in the Semiconductor Packaging University Program learn about the semiconductor industry and take a deep dive into the final step of chip manufacturing. This is the phase in which the chip is packaged in its housing. Chip packaging is becoming increasingly complex and multidisciplinary, while costs must remain low. Developments such as integrated photonics, system-on-chip, embedded cameras, 5G antennas, sensors and micro-electro-mechanical systems place high demands on the manufacturing process... and the competences of semiconductor staff.

Setup
The program focuses on the design and manufacturing of semiconductor packages and the associated assembly, reliability and test techniques. It consists of 2 blocks of nine and ten weeks respectively. In the first block, you study the theory of semiconductor packaging and assembly:

- Semiconductor packaging
- Advanced applications
- Photonic assemblies
- Basic simulation and testing
- Quality and reliability

You'll find more details on the next page under 'Program content'.

In the second block, you tackle a challenging semiconductor packaging problem together with your fellow participants. You also turn the outcome into a prototype to demonstrate its working principle and feasibility. Production and testing of the prototype take place in the CITC laboratories in Nijmegen or at one of the semiconductor partners. In parallel, you study 2 of the elective subjects below, depending on the project and your personal learning needs:

- Simulation - multi constraints
- Advanced packaging materials
- Quality and reliability
- Industrialization and equipment
- Testing and data analysis

Assessment
The program assessment consists of two parts:
- A written test on the theoretical topics, halfway through the program
- A group presentation in which you present the project and your individual contribution. In the presentation you:
  - Explain your design choices
  - Demonstrate the prototype
  - Evaluate the tests
  - Substantiate the technical and commercial feasibility of implementation

> **"In my work, I have to deal with errors in the packaging of chips. This program helped me to better understand the processing steps of chip packaging. This way I can already identify where things went wrong in the process. That is very useful to us."**
>
> Gwen Visser,
> participant edition
> 2020-2021

Program content

Theme 1
Introduction to semiconductors and packaging

Front-end
- Microelectronics introduction
- Semiconductor physics overview
- Basic process technology steps (litho, etch, doping, ...)
- Integrated photonics introduction

Back-end
- Basic assembly and packaging steps (grinding, dicing, ...)
- Package families overview
- Die attach technologies
- Interconnect technologies
- Encapsulation technologies
- Application specific packaging-1 (RF, power, automotive, health)
- Application specific packaging-2 (MEMS and sensors)

Theme 2
Advanced applications

Application areas and associated requirements
- Consumer (mobile, multimedia, IoT, ...)
- Industrial and B2B (passports, credit cards, machines, ...)
- Automotive (engine control, autonomous driving, V2X, ...)

Advanced packaging techniques
- Wafer level packaging (WLP) principles
- WLP for ICs (WLCSP, FOWLP, FOMP, ...)
- WLP for MEMS (hermetic sealing, openings, ...)
- 3D integration technologies
- Embedded die
- Interposer technologies
- Through package vias (TPV)
- Through silicon vias (TSV)
- Micro bumps
- Photonic assembly packaging
- RF, Antenna in Package
- Advanced materials

Theme 3
Simulation and testing

Simulation
- Numerical methods in scientific computing
- Thermal simulations
- Mechanical simulations
- Design optimization

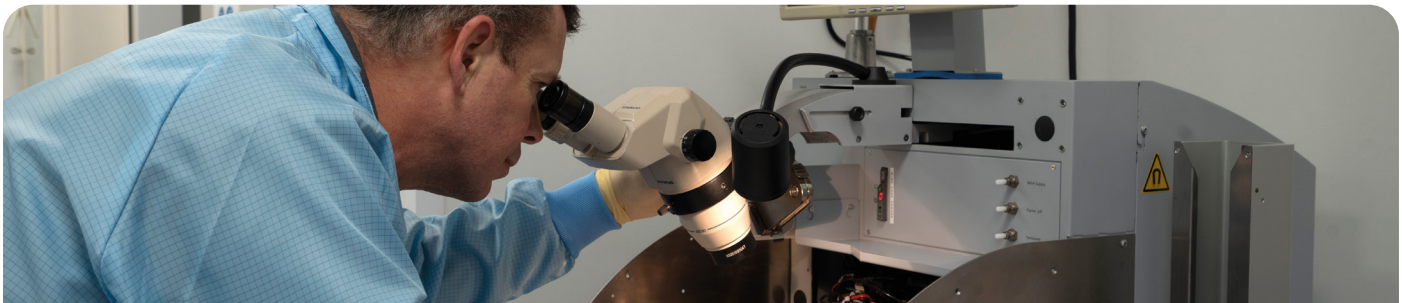
Testing
- Principles of testing
- Back-end test flow (wafer test, acceptance test, final test, ...)
- Tester functionality overview (architecture, probe cards, ...)
- Measurement accuracy (noise, calibration, sensing method, ...)
- Binning/sorting
- Data analysis and water maps
- Test jobs (architecture, limits, ...) and standards (JEDEC)

Theme 4
Quality, reliability and smart manufacturing

Quality
- Basic quality control concepts
- On-line and off-line measurements and tests
- Quality program techniques such as QFD, DoE and SPC
- Quality standards

Reliability
- Basic reliability definition, lifetime distribution and prediction methods
- Physical failure mechanisms in electronic components
- Package-related failures
- Reliability screening and testing
- Failure analysis methods
- Design considerations and system reliability
- Thermal management in relation to package reliability
- Case studies of different package types (low/high power, ...)

Smart manufacturing
- Challenges in manufacturing
- IT infrastructure requirements
- Examples: SNAP, BIM line, digital twin, scheduling



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