

## TRAINING BROCHURE

# Advanced thermal management of electronics - online module



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high tech institute

## Advanced thermal management of electronics

**Price:** € 1,175 excl. VAT \*

**Duration:** 4 consecutive afternoons

**Contact:** [training@hightechinstitute.nl](mailto:training@hightechinstitute.nl), +31 85 401 3600



### Certification

Participants will receive a High Tech Institute course certificate for attending this workshop.

### Trainers

[Clemens Lasance MSc](#)

*\* Prices are subject to change. Price correction will be applied at the end of the year.*

Keep me posted



## Intro

### *Rationale*

Industry moves towards ever increasing functionality, performance, miniaturization and less cost, resulting in higher heat densities and corresponding higher temperatures. Unfortunately, these have a negative impact on the performance, reliability and lifetime of electronic products, making thermal design more challenging than ever.

Optimization of thermal design is relevant for many electronic applications, such as consumer electronics, semiconductors, power electronics, LED applications, automotive, data centers, internet of everything, digital twins etc.

Two very experienced lecturers, [Wendy Luiten](#) (winner of the prestigious Harvey Rosten Award 2014) and [Clemens Lasance](#) (a.o. SEMI-THERM THERMI Award winner in 2001),

teach the participants how to solve the thermal problems inherent in electronics thermal management today. Based on a combined 75-plus years of industrial thermal design experience, they present a balanced mix of theory and practice.

The famous 20+-year old 3-day classroom course, originally intended for inexperienced as well as experienced participants, has been replaced by two modules to meet the requirements of modern times:

- Electronics cooling thermal design (COE-TD; lecturer: Wendy Luiten)

This module is organized either as a 5 half-days online module (via Microsoft Teams) or as a 3 full-days offline classical course. It is intended for engineers not experienced in thermal design.

- Advanced thermal management of electronics (COE-ADV; lecturer: Clemens Lasance)

This module is organized as a 4 half-days online module (via Microsoft Teams). It is intended for engineers familiar with at least the contents of the thermal design module.

We kept the excellent and high-quality contents. We addressed feedback from our previous trainings to change the original course:

- split up the thermal design part and the advanced cooling topics part;
- add much more time to digest the theory;
- provide more opportunities for hands-on practice;
- spend more time on current and future cooling solutions.

The thermal design module allows for more opportunities for practicing and achieving an active skill level for designing new thermal applications, evaluating existing thermal applications, and assessing computational simulation models.

The advanced part builds on this foundation and is scheduled several weeks later. This provides more time to get familiar with the material and facilitates the uptake of the advanced material.

**We strongly advice not to attend only the thermal design part since the advanced thermal management course gives very valuable additional information to assist in preventing thermal problems.**

The new course modules can also be organized in-company, adapted to local needs.

## Objective

After the course, the participant:

- has obtained a thorough understanding of heat transfer phenomena;
- knows the status and challenges in reliability prediction;
- has obtained a basic knowledge of compact thermal modeling;
- has insight in the pros and cons of numerical modeling;
- knows how to measure all relevant thermal parameters;
- knows how to choose the right heat sink and how to deal with heat spreading;
- knows the state-of-the-art and emerging cooling technologies;
- knows about discrepancies between certain theoretical models and reality, and how to cope with these problems.

## Intended for

Engineers (electronic, mechanical/mechatronic, reliability) directly involved with thermal design and cooling of electronic components, modules and systems, engineers confronted with thermal problems/issues, Thermal Engineers, System Architects, or those who want to understand and learn more about this subject of growing importance due to the electronification of society, be it automotive, LEDs, Internet-of-Things or data centers.

Prerequisites: technical college/university education.

*For the module Advanced Thermal Management of Electronics, it is required that the module Electronics Cooling Thermal Design has been attended or an equivalent level of background knowledge is present.*

## Program

The course is scheduled for 4 half days of online training.

The following subjects that have been introduced in the basic course will be treated in more detail and depth:

- conduction, convection and radiation
- reliability and thermal management
- thermal characterization and compact thermal modelling
- heat sinks and heat spreading
- numerical analysis and its accuracy
- measurement techniques and best practices
- state-of-the-art cooling technologies: conduction, air, liquid, microchannel, solid state, and two-phase cooling

Amongst others, the following issues will be discussed:

- Accuracy and measurement of thermal conductivity
- Problems with the heat transfer coefficient and practical solutions
- Problems with dimensionless numbers, laminar and turbulent flow
- Radiation laws, emissivity, practical radiation approach
- Traditional reliability protocols, progress and challenges in reliability prediction
- Problems with the concept of thermal resistance, compact thermal modelling
- Problem solving approaches for thermal management
- About the failure of using heat transfer correlations for practical design
- Heat spreading: important but underestimated
- CFD: the message, its conceivable accuracy and its progress
- Misconceptions about thermocouples, errors, best practices
- High precision thermometry, thermography, steady state vs. transient testing
- How to choose the right heat sink?
- State-of-the-art cooling technologies: interface materials, fans, synthetic jets, microchannel cooling, heat pipes, thermoelectric cooling, etc.

Note: while a number of subjects might not be directly useful for the student in her current job, the mere fact that the student has learned about these subjects may help her in the future in finding the optimal solution.

## Methods

Lectures, quizzes.

Course material: a copy of the slides, the booklet Heat Transfer Theory applied to Electronics Cooling by Lasance & Luiten.

Remarks from participants:

- 'Most important items I've learned: Measurement techniques and advanced cooling strategies' > Atte Formum Focho - Ansys Germany GmbH
- 'Most important items I've learned: overall perspective about thermal calculations and measurements.' > Ercan Ilman - Neways Electronics Int.
- 'Very insightful, very nice to hear lots of personal experiences of the lecturer.' > Bram Lamers , NLR
- 'Helped me to understand, how important is temperature parameters are when developing products. Many practical experiences were shared which made an realistic understanding of the concept. An 40 years of experience shared within 3 days.' > Jinsha Ravindran , Philips Medizin Systeme Böblingen GmbH