

# Microsystems design

Course institution: **Grenoble INP**

**CIME Nanotech**

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## Objective

The objective of the course is to show the physical background and the approaches that are used in the design of MEMS-based sensors and actuators. The course will give an overview of microsystem technology and its applications. The course suits especially well for students who aim for R&D tasks.

## Abstract

Microsystems Technology (MST) is a process technology used to create tiny integrated devices or systems that combine mechanical and electrical components. This technology offers many exciting opportunities in miniaturization of elements in a wide range of applications. The technology using integrated circuit (IC) batch processing techniques is referred to as Microsystems Technology (MST) in Europe, Micro-Electro-Mechanical Systems (MEMS) in the United States, and Micromachines in Japan. Regardless of terminology, the uniting factor of a micro-device is in the way it is made. Micromachining processes such as bulk and surface micromachining, as well as high-aspect-ratio micromachining (HARM) selectively remove parts of the silicon or add additional structural layers to form the mechanical and electromechanical components.

Microsystem devices have the ability to sense, control and actuate on the micro scale, and generate effects on the macro scale. The silicon pressure microsensor used presently in millions of automobiles is the best-known application of microsystem technology.

Micromachined accelerometers are used for triggering air bags and controlling active suspensions and anti-skid brakes. Microactuators are following the success of microsensors. Perhaps the first major commercial application of actuators has been in camera objectives introduced by Canon in 1987. In addition to consumer electronics and automotive industry, microsystems are used in communications technology, chemical and environmental analysis, life science, medical technology and process industry, even in paper making.

## Contents

The course gives an introduction to microsystem technology, design and its applications.

Following issues will be discussed using examples of different MEMS devices design:

- Modelling and simulation of MEMS devices
- Different types of transduction processes used in MEMS
- MEMS based accelerometers
- MEMS based pressure sensors

There are many advantages of microsystems devices over current devices that perform the same functions:

- Substantially smaller size of microsystems comparing to macro-devices that perform the same function.
- Integration of the electronic and microsensor components in the same device improving the precision and sensitivity of sensors.
- Less expensive production by a batch fabrication using IC processes.

The diversity and complexity of the micromachining technology demands a wide knowledge base from a prospect researcher. The goal of this course is to provide the student the needed expertise to approach the development of microsystem devices.

## **Learners**

The primary target groups concerned are: professionals from SMEs in electronics and micro-systems, students in engineering education and vocational schools, educated but unemployed people (e.g. engineers, physicists) looking for additional training for employment.

## **Prerequisite and Corequisite Knowledge**

- Fundamentals of electronics and microelectronics
- Linear electrical circuits
- Basics of electronic design

It is assumed also that learners have a good knowledge of physics (electronics and mechanics).

**Estimated duration of the course:** 30 hours