

**Graduate course**

***Experimental Engineering Mechanics***

**November 28<sup>th</sup> & 29th, 2022**

**Mechanics of Materials  
Department of Mechanical Engineering  
Eindhoven University of Technology**



## General

To design better materials and systems, the mechanical behavior of the material or system in an application, such as damage or failure, needs to be coupled to the deformation of its (micro-)structure in order to elucidate the underlying physical deformation mechanisms. To this end, experimental mechanics seeks to study mechanical deformation through the measurement of forces and strains (under various loading conditions) and, if possible, simultaneous visualization of the microstructural deformation. Such an integration of experimental techniques is often necessary to gain sufficient insight into the complex deformation (micro-)mechanisms. This calls for a careful design of the experiment, as well as a minimum level of understanding of the various existing deformation tests and microscopes in order to select the appropriate experiment, therefore:

*The graduate course on 'experimental engineering mechanics' provides an overview of and introduction to commonly-used experimental deformation and visualization techniques, in which the underlying physical principles will be briefly addressed.*

The graduate course will cover lectures by experienced researchers on topics including:

- design of an optimal experiment considering statistical and systematic accuracies and limitations, also in the context of miniaturization of the experiment,
- mechanical deformation tests, including tensile, bending, compression tests, (nano)-indentation, dynamic testing (fatigue, high speed tests), tribological testing (friction, wear),
- microscopic techniques for visualizing deformation, including optical microscopy (different contrast modes), electron microscopy (including EDX), electron backscatter diffraction (EBSD), and surface profilometry,
- strain field measurement techniques, including digital image correlation (DIC),
- and a short individual 'lab' session (to perform a careful DIC analysis).

Examples from faculty research and literature will be used to illustrate possibilities and restrictions of these techniques.



## Lecturers

- dr. Benoît Blaysat (Université Blaise Pascal, France):  
*lecture on 'Digital Image Correlation'*
- prof. Patricia Verleysen (Ghent university, Belgium):  
*lecture on 'Experimental Dynamics'*
- dr.ir. Matthijn de Rooij (Univ. of Twente):  
*lecture on 'Experimental Tribology'*
- dr.ir. Laurent Warnet (Univ. of Twente):  
*lecture on 'Design of Experiments'*
- ir. Tijmen Vermeij (TU/e):  
*lecture on 'Electron Microscopy & EBSD'*
- dr.ir. Johan Hoefnagels (TU/e):  
*lectures on 'Optical Microscopy' and 'Miniaturization of Experiments'*

## Preliminary time schedule

Preliminary time schedule of EM short course "Experimental Engineering Mechanics", 2022 edition				
	Time	Subject	Lecturer	
Day 1: Monday November 28th	9:00 - 9:15	welcome + coffee		
	9:15 - 9:30	Introduction	Johan Hoefnagels	
	9:30 - 10:20	Experimental Methods	Laurent Warnet	
	coffee break			
	10:30 - 11:20	Experimental Methods	Laurent Warnet	
	coffee break			
	11:30 - 12:20	Miniaturization of Experiments	Johan Hoefnagels	
	Lunch			
	PM	13:30 - 14:20	Experimental Dynamics	Patricia Verleysen
		coffee break		
		14:30 - 15:20	Experimental Dynamics	Patricia Verleysen
		coffee break		
		15:30 - 16:20	Electron Microscopy + EBSD	Tijmen Vermeij
		short break		
16:30 - 17:20		Electron Microscopy + EBSD	Tijmen Vermeij	
17.20 - ... <i>Socializing drink</i>				
Day 2: Tuesday November 29th	AM	9:00 - 9:50	Digital Image Correlation	Benoît Blaysat
		short break		
		10:00 - 10:50	Digital Image Correlation	Benoît Blaysat
		coffee break and installation of Global DIC code on your own laptop		
	11:00 - 12:40		<b>online 'Lab session' on DIC</b>	Johan Hoefnagels
	Lunch			
	PM	13:50 - 14:40	Experimental Tribology	Matthijn de Rooij
		short break		
		14:50 - 15:40	Experimental Tribology	Matthijn de Rooij
		coffee break		
15:50 - 16:50		Optical Microscopy	Johan Hoefnagels	
16:50 - 17:00		Closure + Questionnaire		

## Organization

The course is organized and hosted by Mechanics of Materials group at the Eindhoven University of Technology (TU/e). The local organizing committee is composed of:

- dr.ir. Johan Hoefnagels (*main organizer*)
- Alice van Litsenburg (*secretary*)

## Lecture notes

Lecture notes and course material will be distributed at the start of the course.

## Prerequisites

No prior knowledge is required. The course is set up to give an introduction of the various experimental techniques for those new to the field, while giving specific details for the more experienced experimental researcher.

## Fee/Registration

The course is free for registered members of the graduate school Engineering Mechanics and for the research members of the contributing research groups. The course fee for non EM members is € 100 for students and € 400 for other participants. They will receive an invoice after accepted registration. Participants need to register via our website <https://engineeringmechanics.nl/courses/> before November 15th, 2022. Members of the Graduate School Engineering Mechanics receive priority in case of oversubscription.

## Further information

For more information on the organization of the course, contact:

- Alice van Litsenburg (secretary); E-mail: [A.J.J.T.Litsenburg@tue.nl](mailto:A.J.J.T.Litsenburg@tue.nl)

For more information on the content of the course, contact:

- dr.ir. J.P.M. Hoefnagels (TU/e); E-mail: [J.P.M.Hoefnagels@tue.nl](mailto:J.P.M.Hoefnagels@tue.nl)

Further information about the educational program and other activities of the Graduate School on Engineering Mechanics can be found at: [www.engineeringmechanics.nl](http://www.engineeringmechanics.nl)

