Flow, Structure & Strength elective package

Flow, Structure & Strength	
Offered by	Department of Mechanical Engineering
Language	English
Primarily interesting for	All students, but most relevant for students with background in ME, AP, BME, CE&C
Prerequisites	Required courses: - Recommended courses: Structure and Properties of Materials (4MA00)
Contact person	dr.ir. L.C.A. van Breemen (l.c.a.v.breemen@tue.nl)
Last year of education/exam given	2026-2027

What you will learn

New technologies are often born out of a deeper understanding of materials. Take, for example, the quest for sustainable energy or the desire for more durable constructions. That's where solid and fluid mechanics come in - two critical fields for any mechanical engineer.

But it's not enough to simply understand the theory behind these concepts. Practical experience is vital for success in both academia and industry. That's why this elective package is split into two blocks.

- In the first block, you delve deeper into the theory of solid and fluid mechanics by exploring the underlying microstructures. You discover how tweaking these structures can dramatically alter the mechanical response of a material.

- In the second block, you focus on applying your newfound knowledge to real-world problems. You learn the experimental and numerical skills required to design and create new products and tackle cutting-edge research projects. This block includes hands-on experience with state-of-the-art experimental setups and simulation environments, giving you a firsthand look at the exciting and challenging mechanics research taking place in our department.

Course code	Course name	Level classification
4LB00 (2023-2024 and 2024-2025) Q4 (2025-2026 and 2026-2027) Q3	Strength and Structure	Advanced
4MC00 (2023-2024 and 2024-2025) Q3 4CBLB30 (2025-2026 and 2026-2027) Q4	Experimental and Numerical Skills CBL Mechanical testing	Advanced Advanced
4RC00 (2023-2024 to 2026-2027) Q4	Flow and Structure	Advanced

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TU/e
EINDHOVEN UNIVERSITY OF TECHNOLOGY

Course description

Strength and Structure (4LB00)
Recommended prior knowledge: Structure and Properties of Materials

During the design process of a product, it is crucial to know where, when and how a material fails. You can think of an application in automotive (energy-absorption at a crash), energy (failure behavior of turbine blades, batteries) or microsystems (flexible electronics) or biomedical (prostheses, in-body devices) or security (laminated and/or bulletproof glass), but also a prediction of the life-time of loaded-bearing structures. To describe failure behavior quantitatively, we use computer simulations and pay in this course particular attention to the two most relevant aspects. First, you will learn how plastic deformation is implemented in 3D macroscopic (continuum) material-models (in essence, this is a continuation of what you have learned in 1D in the course Solid Mechanics). The second aspect concerns the multi-scale modelling of materials focused on linking macroscopic behavior to processes that take place in the microstructure. You will recognize that understanding and quantifying these underlying processes explains where, when, and how a material fails macroscopically. And more importantly, how to avoid that.

Experimental and Numerical Skills (4MC00)

In the third, and from an engineering practice, an essential part of the elective package, the specific practical skills are taught in the field of experimentation, numerical modelling, and analysis. This can only be learned through hard work under intensive supervision. Every student will in a total perform five experimental, and modelling projects in the complete area of solid and fluid mechanics: one experimental project in the Multi-scale lab, one in the Polymer Mechanics lab and one in the Microfab lab and finally two numerical projects, one in the area of solid mechanics and one in the area of fluid mechanics. These projects will be executed in groups of several students that make use of the theoretical knowledge from solid and fluid mechanics gained in the courses Solid Mechanics and Fluid Mechanics and the other courses mentioned in this brochure. The projects are chosen in a way that they align with the current research projects in the department on solid and fluid mechanics, by making use of state-of-the-art experimental and numerical research methods.

This course has a maximum of 66 students.

Flow and Structure (4RC00)
The most commonly used liquids in technology (polymer processing, rubbers, lubricating oil), in the food industry (baking products, sauces, cheeses) and in daily life (shampoo, cosmetics, toothpaste) show a more complex behavior than a simple Newtonian fluid. Since liquids form internal structures during flow, because often there is more than one component in the microstructure. This course covers the basis of the modelling of multiple-component systems, the background of the general non-Newtonian constitutive equations, and the rheometry, the field on how to measure these properties. To describe multi-component or multi-phase systems, simple models can sometimes be used, mainly to strengthen the understanding, while the more practical problems often require numerical models.