Erasmus+ Blended Intensive Program

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Nonlinearities in Solid Mechanics: instabilities, waves, plasticity in 1D models

- 5 ECTS (European Credit Transfer System)
- 6 days at Sorbonne University, Paris, March 2-7, 2026
- 3 European universities

National Technical University of Athens

SCIENCES SORBONNE UNIVERSITÉ

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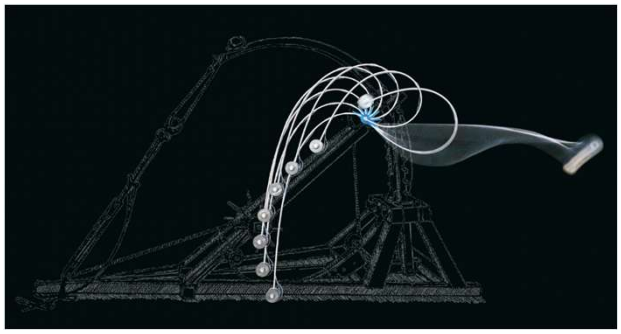
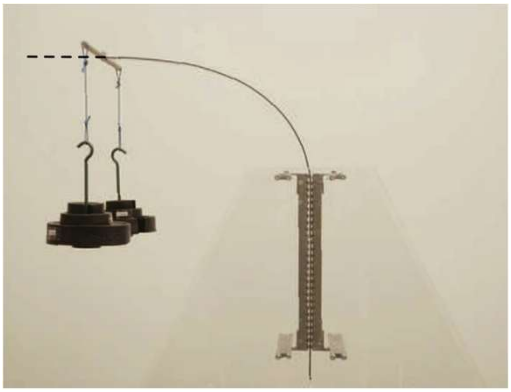
Dive into the fascinating world of nonlinear solid mechanics through a unique blend of theory, computation, and applications. This course guides you from fundamental principles to advanced modeling techniques, equipping you with the tools to analyze and simulate complex nonlinear behaviors in one-dimensional mechanical systems.

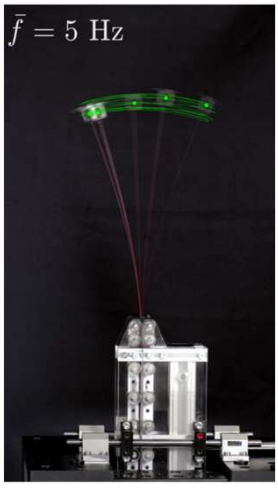




Designed for learners with a basic background in solid mechanics and numerical methods (or calculus), the course is structured into three interconnected parts:

- Optimisation, Calculus of Variations and Numerics
- Nonlinear beams and instabilities
- Waves and inelastic solids

The course will consist of an online introductory lecture (16 February 2026), five days of in-person attendance at Sorbonne University (**2 - 7 March 2026**), and an oral project-based online examination. Approximately 30 students from National Technical University of Athens (Athens, Greece), University of Trento (Italy), and Sorbonne University (Paris University) will participate. Lectures will be delivered by Professors from the three institutions.



During the in-person week at Sorbonne University (Jussieu) in Paris, frontal teaching will be alternated with assisted teamwork. Computer laboratories will also be established.

Eligible applicants for Sorbonne include students in the 5th and 4th year at the School of Applied Mathematical and Physical Sciences with priority to the 5th year students.

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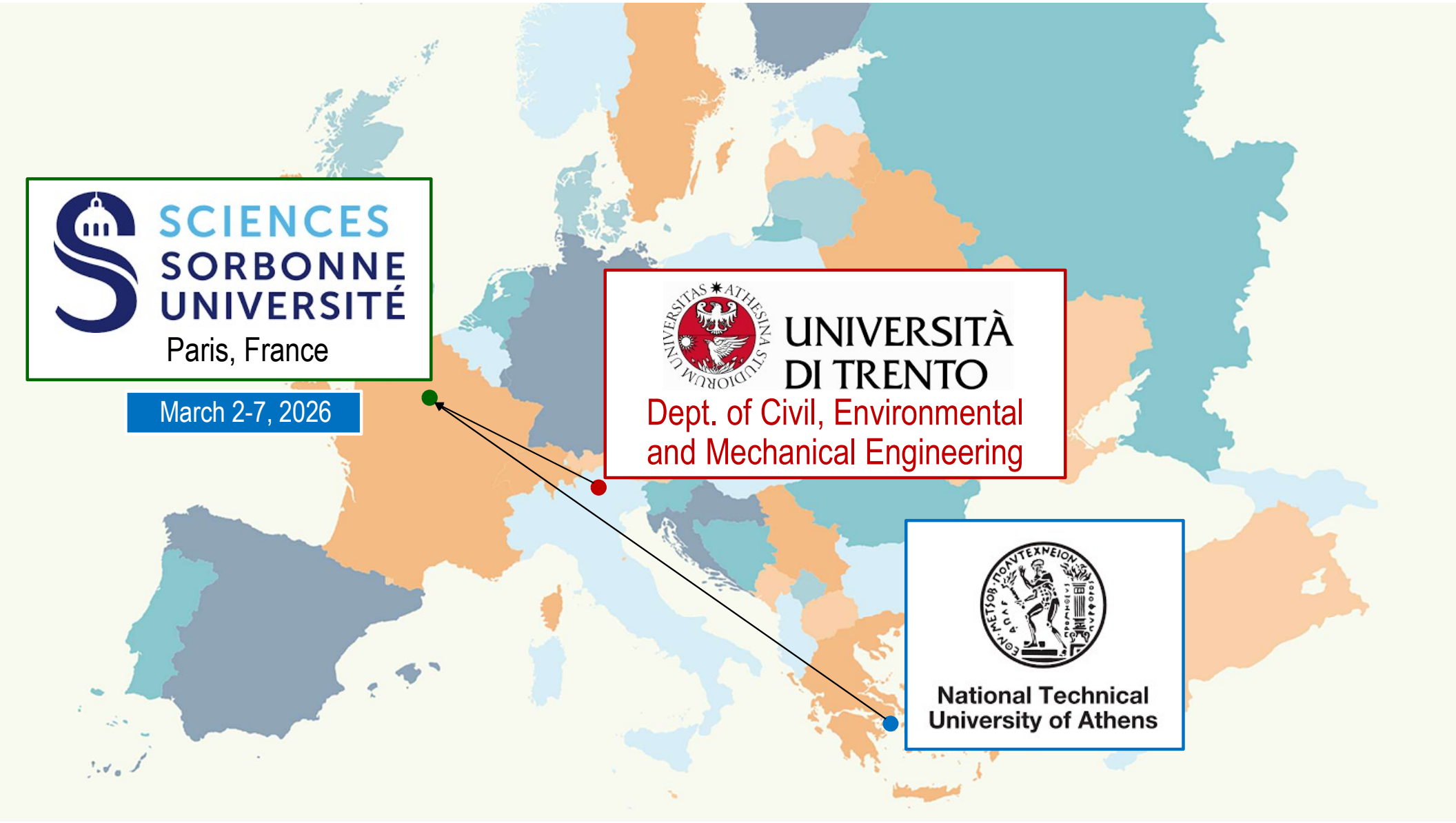
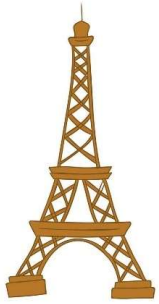

SCIENCES
SORBONNE
UNIVERSITÉ
Paris, France
March 2-7, 2026
UNIVERSITÀ
DI TRENTO
Dept. of Civil, Environmental
and Mechanical Engineering
National Technical
University of Athens

TENTATIVE TIMETABLE

Online introductory lecture: 2 hours, after 17:00 in a day within Feb 7-23, 2026

Lecture week in Paris [March 2-7, 2026]

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9:00-11:00	Lecture 1	Lecture 3	Lecture 5	Lecture 7	Lecture 9	Lecture 11
11:30-13:00	Lecture 2	Lecture 4	Lecture 6	Lecture 8	Lecture 10	Lecture 12
14:00-16:30	Active learning 1	Active learning 2	Active learning 3	Active learning 4	Active learning 5	

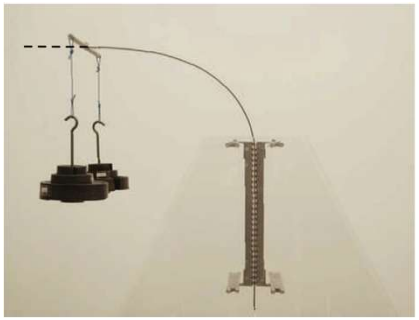


Assessment: Mixed-team project across partner universities. Each group includes at most one NTUA student. Deliverables: report, oral presentation, and final discussion approx. 2 weeks after the BIP.

WHY & HOW TO APPLY

WHY?

funded by **Erasmus+**



Advanced concepts
in nonlinear mechanics

International Experience

5 ECTS (awarded through the Course "Θέμα")

HOW?

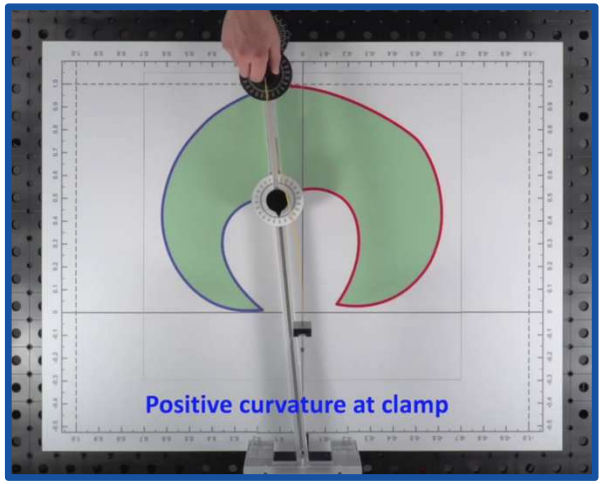
Apply by **November 6, 2025** by filling online the «BIP - "Nonlinearities in Solid Mechanics" form

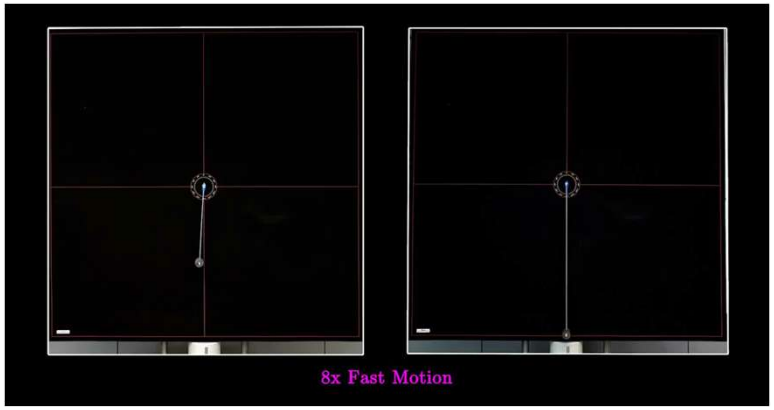
10 Erasmus positions are available. Eligible applicants include students in the fourth and fifth year of the School of Applied Mathematical and Physical Sciences, **with priority given to fifth-year students**. *If applications exceed the available places, selection will be based on grades in Mechanics-stream courses.*

COURSE CONTENT

Part I: Optimisation, Calculus of Variations and Numerics

- Minimizing $V(\boldsymbol{x})$ with $\boldsymbol{x}$ in R^n, without and with equality (kinematics) and inequality (contact) constraints
- Energy functionals and constraints, Euler–Lagrange equations and stability
- Shooting ODEs/IVP/BVP, going discrete, minimizing with Mathematica and Python





Part II: Nonlinear 1D Elasticity

- Kinematics and Statics of the Planar elastica
- Analytical solutions with elliptic integrals
- Euler buckling, snap instability, moving boundary problems (variable length)
- Discretization of the equations
- Stability

Part III: Waves and inelastic models in 1D

- Vibrations and flexural waves
- 1D plasticity: elastic–plastic response with hardening effects
- Viscoplasticity, hysteresis, and cyclic loading