COMPUTATIONAL MECHANICS

Institution: DICAr (UniPV)
Term: 1st Semester – Academic Year 2024-2025
Instructor: Simone Morganti (simone.morganti@unipv.it)
CFU: 6
SSD: ICAR/08
Duration: Thursday, 21/11/2024 – Friday, 20/12/2024
(lectures: 36 academic hours; tutorials: 15 academic hours)
Classroom: MS1 (Dept. of Civil Eng. and Arch., ground floor)
Schedule: [type: L = lecture, T = tutorial]

Nov. 21-22:			Thu 14:30-17:30 (L);	Fri 14:00-17:00 (L)
Nov. 25-29:	Mon 14:30-17:30 (L);	Wed 14:00-16:15 (T);	Thu 14:30-17:30 (L);	Fri 14:00-17:00 (L)
Dec. 2-6:	Mon 14:00-16:15 (T);	Wed 14:30-17:30 (L);	Thu 14:30-17:30 (L);	Fri 14:00-16:15 (T)
Dec. 9-13:		Wed 14:30-17:30 (L);	Thu 14:30-17:30 (L);	Fri 14:00-16:15 (T)
Dec. 16-20:	Mon 14:00-17:00 (L);	Tue 14:00-16:15 (T)		

Note: lectures will consist of academic hours of 45' each
Office hours: by appointment
Final exam: Dec 20, Fri, 14:30-16:30

OBJECTIVES

The objective of the course is to introduce students to classical Computational Mechanics tools, and, in particular, to the most widely used one, namely, the finite element method. The main aim is building a deep knowledge of the basic ideas, the potential, and the limitations of the finite element method, both from the theoretical and the practical point of view, also through the development of simple codes for the simulation of frames and solid mechanics problems.

DESCRIPTION

Theoretical lectures will be complemented by tutorials (aiming at the practical implementation in Matlab of the methods considered during the lectures) and the topics that will be covered during the course are reported in the following.

Course contents: Review of beam theory and of standard displacement-based methods for planar frames. Basic concepts of the finite element method and development of a finite element scheme for Bernoulli-Euler beams, starting from the elastica differential equation. Development of a finite element scheme for (sheardeformable) Timoshenko beams starting from the total potential energy. Shear locking issues and possible solution techniques. Review of linear elasticity. Finite elements for linear elasticity in 1D and 2D. Development of triangular and isoparametric quadrilateral finite elements. Numerical integration. Volumetric locking issues and possible solution techniques. Review of advanced Computational Mechanics methods.

REQUIREMENTS

Intermediate/good knowledge of algebra, mechanics of solids (basic concepts of strain and stress), numerical analysis.

REFERENCES

- Course notes.
- T.J.R. Hughes, "The Finite Element Method: Linear Static and Dynamic Finite Element Analysis". Dover, 2000.
- O.C. Zienkiewicz, and R.L. Taylor. "The finite element method for solid and structural mechanics". Elsevier, 2005.

ASSESSMENT

Assignments will be handed over during the course. The final examination will consist of a written (closedbook) test. Grading: 40% assignments, 60% final exam.

[The final written test might be substituted by an oral examination in special situations identified by the teacher]