I. General Course Information

Instructor:	Prof. Kostas Karapiperis, konstantinos.karapiperis@epfl.ch
TAs:	Thomas Henzel, thomas.henzel@epfl.ch
	Hrishikesh Menon, hrishikesh.menong@epfl.ch
	Dr. Govinda Padmanabha, govinda.ananthapadmanabha@epfl.ch
Lectures:	Wednesdays 16:00-18:00 pm, DIA 003
Exercises:	Thursdays 09:00-11:00 am, DIA 005
Office hours:	By appointment.
Class material:	All course-related material can be found on Moodle.
	Slides uploaded each week.
Exams:	Evaluation throughout the semester. No final exam.
Policy	Students are expected to attend all lectures and exercise sessions. Please bring your computers during exercise sessions of weeks 2,3,4,5,7,8,10. Collaboration during the exercise sessions is allowed and encouraged, yet everyone should ultimately produce their own Python implementation for each project. Late submissions of project reports will not be accepted. Final presentations of research papers will be 20 minutes long each. The dates assigned to each presentation will be uploaded to Moodle.
Grading	Project 1 (40%), Project 2 (40%), Final Presentation (20%)
Contents	The course introduces students to the fundamentals of multiscale modeling applied to mechanics problems. We cover principles and techniques for modeling materials across different spatial scales, from the level of atoms or grains to the continuum or structural scale. Emphasis is placed on hierarchical upscaling (homogenization), while asymptotic and concurrent techniques are also covered.
Prerequisites	Continuum Mechanics (e.g. CIVIL-225)
	Finite Elements (e.g. CIVIL-321)
	Numerical analysis (e.g. MATH-251a)

II. Tentative syllabus

Week	Date	Topic	Type	Resp.	Room
1	10/09/2025	Introduction to multiscale modeling, Review of Continuum mechanics	Lecture	K.K.	DIA 003
	11/09/2025	No exercises during first week	-	-	-
2	17/09/2025	Periodic & random microstructures, RVEs, Averaging Theorems	Lecture	K.K.	DIA 003
	18/09/2025	Python - Fundamentals	Exercise	G.P.	DIA 005
3	24/09/2025	Continuum-to-continuum homogenization, Hill-Mandel condition	Lecture	K.K.	DIA 003
	25/09/2025	Python - Advanced topics	Exercise	G.P.	DIA 005
4	01/10/2025	RVE boundary conditions, Effective moduli, Bounds	Lecture	K.K.	DIA 003
	02/10/2025	Project 1 - Exercises	Exercise	T.H.	DIA 005
	02/10/2025	Project 1 Assigned			
5	08/10/2025	Analytical and asymptotic homogenization	Lecture	K.K.	DIA 003
	09/10/2025	Project 1 - Exercises	Exercise	T.H.	DIA 005
6	15/10/2025	Discrete Element Method	Lecture	K.K.	DIA 003
	16/10/2025	Project 1 - Office hours	Exercise	T.H.	DIA 005
-	22/10/2025	No lecture (Semester break)	-	-	-
	23/10/2025	No exercises (Semester break)	-	-	-
7	29/10/2025	Discrete Element Method, Discrete-to-continuum homogenization	Lecture	K.K.	DIA 003
	30/10/2025	Project 2 - Exercises	Exercise	H.M.	DIA 005
	30/10/2025	Project 1 Due, Project 2 Assigned			
8	05/11/2025	Molecular dynamics, Atomistic ensembles	Lecture	K.K.	DIA 003
	06/11/2025	Project 2 - Exercises	Exercise	H.M.	DIA 005
9	12/11/2025	Concurrent multiscale modeling	Lecture	K.K.	DIA 003
	13/11/2025	Project 2 - Office hours	Exercise	H.M.	DIA 005
10	19/11/2025	Data-driven multiscale modeling	Lecture	K.K.	DIA 003
	20/11/2025	Data-driven multiscale modeling	Exercise	K.K.	DIA 005
	27/11/2025	Project 2 Due			
11	26/11/2025	Applications to various materials	Lecture	K.K.	DIA 003
	27/11/2025	Final presentation discussion	Discussion	K.K.	DIA 005
12	03/12/2025	Applications to various materials	Lecture	K.K.	DIA 003
	04/12/2025	Final presentation discussion	Discussion	K.K.	DIA 005
13	10/12/2025	Final presentations	Presentations	K.K.	DIA 003
	11/12/2025	Final presentations	Presentations	K.K.	DIA 005
14	17/12/2025	Final presentations	Presentations	K.K.	DIA 003
	18/12/2025	Final presentations	Presentations	K.K.	DIA 005