Imperial College London

Module Outline

Computational Methods 2

Module Code	CIVE50003	FHEQ Level	Level 5
Pre-requisites	N/A	Co-requisites	N/A
Teaching Term	Autumn and Spring	Available for CPD (MSc only)	No
Primary Department	Civil & Environmental Engineering		
Module Leader	Mashayeki, Ali		
Additional Teaching Departments	N/A		
Teaching Staff	Mashayeki, Ali; Sadowski, Adam;		

Programmes on which the Module is delivered	Core/Elective
MEng Civil Engineering (H201)	Core
MEng Civil Engineering with a Year Abroad (H202)	Core
Civil Engineering (H21E)	Core

Module Overview	In this module you will have the opportunity to solve a wide range of problems in Civil and Environmental Engineering using Matlab. You will learn, from hands-on experience, about concepts of computer-assisted engineering, graphical presentation, and programming. The module builds explicitly on the material taught in Computational Methods I and incorporates applications drawn from across the undergraduate course.
Learning Outcomes	Upon successful completion of this module you will be able to: • Perform numerical differentiation and integration in more than one dimension. • Numerically solve linear and non-linear differential equations with Matlab. • Explain the approximations involved in numerical estimations of gradients and integrals (order of accuracy, truncation errors). • Explain the principles of finite difference and finite element methods. • Apply the theory and principles underlying all commercial FE software. • Write your own code to solve structural analysis problems (trusses, beams, frames) using classical finite elements. • Use Matlab classes with an understanding of the basics of object-oriented programming.

Description of Content	Data processing and numerical calculus: Vectorisation of loops. Numerical differentiation in more than one dimension. Numerical integration in more than one dimension. Numerical integration on non-rectangular domains. Numerical methods for Ordinary Differential Equations: Discretisation in time/space. Time integration schemes: Euler, Runge-Kutta, adaptive schemes. Non-linear ODEs. Applications to the decay of pollutants, earthquake analysis, and fluid mechanics. Finite Element Method: Introduction to Finite Element (FE) analysis – strong vs. weak statement and Galerkin. FE system matrix assembly. Bar element. General 2D bar elements for trusses. Euler-Bernoulli beam elements. Timoshenko beam elements. General 2D beam element for frames. Introduction to object-oriented programming for the Matlab FE project.

Assessment
Assessment information will be provided separately.

Learning & Teaching Hours	Independent Study Hours	Placement Hours	Total Hours
40	85	0	125
ECTS Credit	5	CATS Credit	10
Date of introduction	1/10/2020	Date of Last Revision	2/9/2020

Reading Lists:

Category as defined by Central Library:

C = Core, S = Supplementary
