



Course Syllabus: Computational Geophysics - ErSE 326

Division	Physical Science and Engineering Division
Course Number	ErSE 326
Course Title	Computational Geophysics
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	09:00 AM - 10:30 AM Wed Thu

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Daniel Bernhard Peter	daniel.peter@kaust.edu.sa		0146, 1, Al-Khwarizmi (bldg. 1)	

Teaching Assistant(s)	
Name	Email

Course Information	
Comprehensive Course Description	The course provides an introduction to different numerical methods applied to geophysical problems. In particular, the finite-difference, pseudo-spectral, finite-element, and spectral-element methods will be presented and applied to basic geophysical problems including heat flow and wave propagation. The course offers hands-on lab experience in numerically solving partial differential equations relevant to geophysics. The students will program simple versions of these methods.
Course Description from Program Guide	The course provides an introduction to different numerical methods applied to geophysical problems. In particular, the finite-difference, pseudo-spectral, finite-element, and spectral-element methods will be presented and applied to basic geophysical problems including heat flow and wave propagation. The course offers hands-on lab experience in numerically solving partial differential equations relevant to geophysics. The students will program simple versions of these methods.
Goals and Objectives	Students will acquire the skills to program different numerical methods relevant for solving geophysical problems, in particular for heat flow and wave propagation.
Required Knowledge	Introduction to geophysics, partial differential equations and basic programming experience.
Reference Texts	-
Method of evaluation	80.00% - Homework /Assignments 20.00% - Quiz(zes)
Nature of the assignments	Hands-on programming exercises and computer lab reports
Course Policies	Late home works only accepted with consent of instructor.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Wed 08/28/2019	Introduction to conservation laws for heat flow and wave propagation
1	Thu 08/29/2019	Introduction to conservation laws for heat flow and wave propagation; hands-on parallelization
2	Wed 09/04/2019	Finite-differences method for heat flow
2	Thu 09/05/2019	Finite-differences method for heat flow; hands-on
3	Wed 09/11/2019	Finite-differences method for wave propagation
3	Thu 09/12/2019	Finite-differences method for wave propagation; hands-on
4	Wed 09/18/2019	Higher-order Finite-differences method for tsunami waves
4	Thu 09/19/2019	Higher-order Finite-differences method for tsunami waves; hands-on
5	Wed 09/25/2019	Introduction to Pseudo-spectral method
5	Thu 09/26/2019	Introduction to Pseudo-spectral method; hands-on
6	Wed 10/02/2019	Pseudo-spectral method for wave propagation
6	Thu 10/03/2019	Pseudo-spectral method for wave propagation; hands-on
7	Wed 10/09/2019	Introduction to Finite-element method
7	Thu 10/10/2019	Introduction to Finite-element method; hands-on
8	Wed 10/16/2019	Finite-element method for steady-state heat flow
8	Thu 10/17/2019	Finite-element method for steady-state heat flow; hands-on
9	Wed 10/23/2019	Finite-element method for unsteady-state heat flow
9	Thu 10/24/2019	Finite-element method for unsteady-state heat flow; hands-on
10	Wed 10/30/2019	Introduction to spectral-element method
10	Thu 10/31/2019	Introduction to spectral-element method; hands-on
11	Wed 11/06/2019	Spectral-element method for heat flow
11	Thu 11/07/2019	Spectral-element method for heat flow; hands-on
12	Wed 11/13/2019	Spectral-element method for 1D wave propagation
12	Thu 11/14/2019	Spectral-element method for 1D wave propagation; hands-on
13	Wed 11/20/2019	Spectral-element method for 2D elastic wave propagation
13	Thu 11/21/2019	Spectral-element method for 2D elastic wave propagation ; hands-on
14	Wed 11/27/2019	Spectral-element method for 3D viscoelastic wave propagation
14	Thu 11/28/2019	Spectral-element method for 3D viscoelastic wave propagation; hands-on
15	Wed 12/04/2019	Physics-based ground shaking simulations
15	Thu 12/05/2019	Physics-based ground shaking simulations; student presentations

Note

The instructor reserves the right to make changes to this syllabus as necessary.