POLITECHNIKA GDAŃSKA

DOCTORAL SCHOOL AT GDAŃSK UNIVERSITY OF TECHNOLOGY

Course: Advanced numerical methods in mechanics

Teaching hours: 45h

Prerequisites: The course is primarily open to all PhD students at Gdansk University of Technology.

This course is compulsory for PhD students assigned to mechanical engineering as well as applied mathematics tracks at Doctoral School at Gdańsk University of Technology

Course outline

Content
This module is all about getting the student to be prepared to conduct advanced numerical simulations. The sessions provide essential information that you require to understand modern and contemporary numerical methods of solving partial differential equations and not only. The course is designed to deliver to students knowledge on modern numerical methods. Throughout the course the students should gain skills to understand and conduct research based on numerical methods.

General topics coverage:

1. Molecular dynamics
2. Dissipative particle dynamics
3. Finite difference method
4. Finite element method
5. Finite volume method
6. Lattice Boltzmann method
7. Smoothed particle hydrodynamics
8. Monte Carlo method
9. Turbulence modelling

Teaching mode

There will be 15/30 hours of laboratories/lectures, to be completed during the first and/or second semesters of PhD programme. The teaching method is basically presentation combined with computer laboratory. During the course students will be

asked to participate in lecture and laboratory classes. The course is entirely delivered in English.

Examination

A wide range of formative feedback from your tutor, questions and practical individual and group exercises will be used by tutors to aid learning as will exercises to encourage the researchers' abilities in critical and reflective learning. The exact nature of these assessment devices will be at the discretion of the tutor. The PhD students will be required to demonstrate their skills, knowledge and understanding of numerical methods during an oral/written examination.

Fundamental readings:

1. Ferziger J.H., Perić M., Computational Methods for Fluid Dynamics, Springer-Verlag, Berlin, 2002
2. Pope S. B., Turbulent Flows, Cambridge University Press, Cambridge, 2000
3. Succi S., The Lattice Boltzmann Equation for Fluid Dynamics and Beyond, Oxford University Press, Oxford, 2001
4. Wilcox D. C., Turbulence Modeling for CFD, DCW Industries, California, 1994
5. Zienkiewicz O. C., Taylor R. L., The Finite Element Method, Butterworth-Heinemann, Oxford, 2000
6. Tesch K., Fluid Mechanics, Wyd. PG, 2008, 2013 (in Polish)
7. Groot R. D., Warren P. B., Dissipative particle dynamics: Bridging the gap between atomistic and mesoscopic simulation, The Journal of Chemical Physics, 107, pp 4423–4435, 1997
8. Monaghan J. J., Smoothed Particle Hydrodynamics, Annual Review of Astronomy and Astrophysics, 30, pp 543–574, 1992