MODULE INFORMATION SHEET

Name of Module Unit	**Computational Methods in Environmental Engineering**
Name in polish language	Metody obliczeniowe w inżynierii środowiska
Module type	compulsory / ~~elective~~
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	-
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Dept. of Informatics and Environment Quality Research
Responsible person	dr inż. Wiktor Treichel

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
1	30E			15		3

Learning outcomes (knowledge, skills, competences)

The objective of this course is to deliver basic knowledge of numerical methods applied to environmental problems.
On successful completion of this course student should:
- have knowledge of fundamental methods of numerical analysis,
- know how to apply different methods to particular environmental problems.

Computer assignments using Matlab and Excel give the students an opportunity to practice their skills at scientific programming and computer-based problem solving.
Competences: confirmed ability of applying knowledge in particular problems and applications.

Prerequisites

Mathematics – Algebra+Calculus, Physics I and II, Information Technology, Informatics

Rules for integrated grade setting

60% (examination grade) + 40% (computer exercises grade)

Recommended readings

1. Kincaid D., Cheney W. - Numerical Analysis. Mathematics of Scientific Computing, Thomson Learning Inc. 2002
2. Mathews J. H., Fink K. D. – Numerical Methods using Matlab, Pearson Education Inc., 2004
3. Holzbecher E. – Environmental Modeling using Matlab, Springer Verlag 2007
4. Cutlip M. B., Shacham M. – Problem Solving in Chemical and Biochemical Engineering with Polymath, Excel and Matlab, (second edition), Pearson Education Inc., 2008

Contents of lectures (syllabus)

	Topics	Time (hrs.)	Scope (S / Ex)
1	Basic mathematical tools in computational methods, review of calculus, error analysis	2	S
2	Solution of nonlinear equations. Bisection, Newton-Raphson and secant methods. Fluid mechanics examples.	4	S
3	Solution of linear equation systems, Gaussian elimination and iterative methods.	4	S
4	Interpolation and polynomial approximation	2	S
5	Curve fitting, least-square method, estimation of parameters in environmental models	2	S
6	Numerical differentiation and numerical integration	2	S
7	Numerical solution of ordinary differential equation and systems of equations. Euler's method. Runge-Kutta methods.	4	S
8	Numerical solution of partial differential equations. Parabolic, hyperbolic and elliptic equations. Implicit and explicit methods. Finite-difference method. Introduction to finite-element method.	6	S
9	Introduction to numerical optimization. Minimization of a function of one variable. Linear and nonlinear programming.	4	Ex
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

dr inż. Wiktor Treichel

Assessment method

Written exam

Contents of computer exercises

	Topics	Time (hrs.)	Scope (S / Ex)
1	Introduction to problem solving using mathematical software (Matlab, Excel)	1	S
2	Solving nonlinear equations.	2	S
3	Solving systems of linear equations.	1	S
4	Interpolation of data and estimation of parameters in environmental models.	2	S
5	Examples of ordinary differential equations	3	S
6	Examples of partial differential equations in 1D and 2D	3	S
7	Numerical optimization	3	Ex
	Total	**15**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for computer exercises

dr inż. Wiktor Treichel

Assessment method for computer exercises

Class participation, timely realization of assigned tasks