

DESCRIPTION OF THE COURSES

- Course code: ARR2104
- Course title: NUMERICAL METHODS
- Language of the lecturer: Polish

<i>Course form</i>	<i>Lecture</i>	<i>Classes</i>	<i>Laboratory</i>	<i>Project</i>	<i>Seminar</i>
<i>Number of hours/week*</i>	1			2	
<i>Number of hours/semester*</i>	15			30	
<i>Form of the course completion</i>	pass			pass	
<i>ECTS credits</i>	1			2	
<i>Total Student's Workload</i>	30			60	

- Level of the course (basic/advanced): basic
- Prerequisites:
completed courses: Mathematical Analysis, Fundamentals of Computer Science.
- Name, first name and degree of the lecturer/supervisor:
Eugeniusz Rosołowski, Prof., Ph.D., D.Sc.
- Names, first names and degrees of the team's members:
Jan Iżykowski, Ph.D., D.Sc.
Mirosław Łukowicz, Ph.D.
- Year: 3 Semester: 6
- Type of the course (obligatory/optional): obligatory
- Aims of the course (effects of the course):
The course provides descriptions of basic numerical techniques used in engineering practice.
- Form of the teaching (traditional/e-learning): traditional
- Course description:
The course consists of the lecture and laboratory classes. Both of these forms deal with the following problems: Algorithmic approach to solution of engineering problems. Simultaneous linear algebraic equations: basic solution methods, matrix inversion. Approximation of measurement data through method of least squares. Non-linear algebraic equations: basic solution methods for one and simultaneous equations. Numerical integration and differentiation. Numerical solution of ordinary differential equations. Basic computer programs for solving of engineering problems.
- Lecture:

<i>Particular lectures contents</i>	<i>Number of hours</i>
1. Representation of numbers in computers. Correctness of algorithms, computational burden. Errors of numerical procedures. Gauss elimination method for solution of algebraic equations, LU method.	2
2. Matrix operations, calculation of determinants and matrix inversion. Interpolation - different methods.	2
3. Curve fitting by means of least error squares method, smoothing of	2

	<i>measurement data.</i>	
4.	<i>Solution of non-linear equations: iterative methods, Newton and secant methods and its modifications.</i>	2
5.	<i>Simultaneous non-linear equations: Newton-Raphson method.</i>	2
6.	<i>Solution of ordinary differential equations. Single-step and multi-steps methods.</i>	2
7.	<i>Stability of methods for solving differential equations.</i>	2
8.	<i>Test.</i>	1

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
- Project – the contents:
 1. Gauss elimination method for solution of algebraic equations.
 2. Seidel method for solution of algebraic equations.
 3. Investigation of interpolation of functions with use of different methods.
 4. Investigation of curve fitting by means of the least error squares error method under different basis functions.
 5. Application of SVD algorithm to the least error squares problems solution.
 6. Solution of non-linear equations by means of the direct iteration with the Aitken's correction.
 7. Solution of non-linear equations by means of the Newton-Raphson method. Graphical interpretation of the solution.
 8. Numerical integration procedures.
 9. Euler and trapezoidal methods for solution of differential equations – computer simulation of the selected transient phenomena.
 10. Solution of differential equation sets by means of the Runge-Kutta IV order method – the example of computer simulation of the selected transient phenomenon.
- Basic literature:
 - [1] Yang W.Y., Cao W., Chung T.-S., Morris J., Applied Numerical Methods Using MATLAB. Wiley-Interscience, 2005.
 - [2] Mathews J.H., Fink K.D., Numerical methods using MATLAB. Prentice Hall, 2004.
- Additional literature:
 - [1] Al-Khafaji A.W., Tooley J.R., Numerical methods in engineering practice, New York, Holt, Rinehart and Winston, Inc. 1986.
 - [2] Fortuna Z., Macukow B., Wąsowski J., Metody numeryczne. WNT, Warszawa, 2003.
 - [3] Stachurski M., Metody numeryczne w programie Matlab. Wydawnictwo MIKOM Warszawa, 2003.
 - [4] Jankowscy J. I M., Przegląd metod i algorytmów numerycznych, cz.1, WNT, Warszawa, 1981
 - [5] Dryja M., Jankowscy J. I M., Przegląd metod i algorytmów numerycznych, cz.2, WNT, Warszawa, 1982
 - [6] Kielbasiński A., Schwetlick H., Numeryczna algebra, WNT, Warszawa, 1992.

[7] Press W.H., Teukolsky S.A., Vetterling W.T., Flannery B.P.: „Numerical recipes in C. The art of scientific computing”. Cambridge University Press, Cambridge 1992. On-line: <http://www.library.cornell.edu/nr/cbookcpdf.html>

- Conditions of the course acceptance/creditation: test pass, project pass

* - depending on a system of studies