(*faculty stamp*)



**COURSE DESCRIPTION**

| | |
|---|---|
| **1. Course title:** NUMERICAL ALGORITHMS | **2. Course code** |
| **3. Validity of course description: from 2015/2016** | |
| **4. Level of studies:** BSc programme / **MSc programme** | |
| **5. Mode of studies: intramural studies** / extramural studies | |
| **6. Field of study**: POWER ENGINEERING | (RIE) |
| **7. Profile of studies: general** | |
| **8. Programme:** Modernization of Power Installations | |
| **9. Semester: 1** | |
| **10. Faculty teaching the course:** INSTITUTE OF POWER ENGINEERING AND TURBOMACHINERY | |
| **11. Course instructor**: Sebastian Rulik, PhD | |
| **12. Course classification: general subjects** | |
| **13. Course status: compulsory** /elective | |
| **14. Language of instruction:** English | |
| **15. Pre-requisite qualifications:** mathematics, Information Technologies, Basics of computer science and programming, | |
| **16. Course objectives:**<br>Introduction to basic numerical methods and possibilities of their application. | |
| **17. Description of learning outcomes:** | |

| Nr | Learning outcomes description | Method of assessment | Teaching methods | Learning outcomes reference code |
|---|---|---|---|---|
| 1. | Student understands and is able to apply basic numerical methods in solving complex mathematical problems and knows their application in the power engineering. | Test | Lecture | K_W05<br>K_W07<br>K_U19 |
| 2. | Student knows and is able to practically use the selected numerical methods for the elaboration of research results. | Test | Lecture | K_W05<br>K_W07<br>K_U19 |
| 3. | Student is able to apply selected methods of integration and differentiation to solve engineering problems. | Test | Laboratory | K_W05<br>K_W07<br>K_U19 |
| 4 | Student can describe and apply selected optimization techniques and knows their application in design process. | Test | Laboratory | K_W05<br>K_W07<br>K_U19 |
| 5 | Student can use selected numerical algorithms and is able to apply them in solving engineering problems. | Test | Laboratory | K_U08<br>K_U09<br>K_U19<br>K_U20<br>K_U23 |
| 6. | Student is able to individually create complex computer applications using a number of numerical methods and algorithms in a specific programming language. | Test | Laboratory | K_U08<br>K_U09<br>K_U19<br>K_U20<br>K_U23 |

**18. Teaching modes and hours**

**Lecture 30 / BSc /MSc Seminar / Class / Project / Laboratory 30 Sem. 1**

**19. Syllabus description:**

**Lecture.**
Presentation of basic numerical methods and algorithms concerning the following problems: solving systems of linear equations, nonlinear equations and systems of nonlinear equations, interpolation and approximation methods including single- and multi-variable functions, numerical integration and differentiation, optimization with the use of gradient based methods and heuristic methods, . e.g. genetic algorithms, optimization with the use of meta models based on neural networks.

**Laboratory.**
Application of presented during the lecture selected numerical methods using Visual Basic for Applications programming language. Issues taken under consideration includes:
- Selected methods of solving systems of linear equations - Gaussian elimination method, Simple iteration method,
- Selected methods of solving nonlinear equations - Bisection method, Newton method and False Position Method,
- Interpolation of single variable function: polynomial interpolation and Lagrange polynomial,
- Approximation using the method of least squares
- Integration using the method of rectangles, trapezoids and Simpson's formula
- Solving differential equations using the Euler method and its improvements.

**20. Examination: no**

**21. Primary sources:**


- Hoffman J. D., NUMERICAL METHODS FOR ENGINEERS AND SCIENTISTS, Marcel Dekker, Inc, New York, 2001
- Press W. H., Teukolsky S. A., Wotterling W. T., Flannery, NUMERICAL RECEIPES: THE ART. OF SCIENTIFIC COMPUTING, Cambridge Univeristy Press, 1990
- Majchrzak E, Mochnacki B., METODY NUMERYCZNE. PODSTAWY TEORETYCZNE, ASPEKTY PRAKTYCZNE I ALGORYTMY, Wyd. Pol. Śląskiej, Gliwice, 1994
- Michalewicz Z., ALGORYTMY GENETYCZNE + STRUKTURY DANYCH = PROGRAMY EWOLUCYJNE, Wydaw. Naukowo-Techniczne, Warszawa, 2003


**22. Secondary sources:**


- Collins G. W. FUNDAMENTAL NUMERICAL METHODS AND DATA ANALYSIS, ADS Digital Library, 2003
- Szmelter J., METODY KOMPUTEROWE W MECHANICE, PWN Warszawa, 1980


**23. Total workload required to achieve learning outcomes**

| Lp. | Teaching mode : | Contact hours / Student workload hours |
|---|---|---|
| 1 | Lecture | 30/30 |
| 2 | Classes | / |
| 3 | Laboratory | 30/30 |
| 4 | Project | / |
| 5 | BA/ MA Seminar | / |
| 6 | Other | / |
| | Total number of hours | 60/60 |

**24. Total hours: 120**

**25. Number of ECTS credits: 4**

**26. Number of ECTS credits allocated for contact hours: 2**

**27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1**

**26. Comments:**

Approved:

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*(date, Instructor's signature)*

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(*date , the Director of the Faculty Unit signature)*