## MODULE DESCRIPTION

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| Module code | |
| Module name | **Metody obliczeniowe** |
| Module name in English | **Computational Methods** |
| Valid from academic year | **2012/2013** |

## MODULE PLACEMENT IN THE SYLLABUS

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|---|---|
| Subject | **Computer Science** |
| Level of education | **1st degree**<br>*(1st degree / 2nd degree)* |
| Studies profile | **General**<br>*(general / practical)* |
| Form and method of conducting classes | **Full-time**<br>*(full-time / part-time)* |
| Specialisation | |
| Unit conducting the module | **The Department of Computer Science Applications** |
| Module co-ordinator | **Prof. Aleksander Jastriebow, PhD hab., Eng.** |
| Approved by: | |

## MODULE OVERVIEW

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|---|---|
| Type of subject/group of subjects | **Major**<br>*(basic / major / specialist subject / conjoint / other HES)* |
| Module status | **Compulsory**<br>*(compulsory / non-compulsory)* |
| Language of conducting classes | **English** |
| Module placement in the syllabus - semester | **5th semester** |
| Subject realisation in the academic year | **Winter semester**<br>*(winter / summer)* |
| Initial requirements | **Mathematics, Programming**<br>*(module codes / module names)* |
| Examination | **Yes**<br>*(yes / no)* |
| Number of ECTS credit points | **5** |

| Method of conducting classes | Lecture | Classes | Laboratory | Project | Other |
|---|---|---|---|---|---|
| **Per semester** | **30** | | **30** | | |

## TEACHING RESULTS AND THE METHODS OF ASSESSING TEACHING RESULTS

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| **Module target** | The aim of the module is to familiarise students with: the basics of the methods as well as numerical algorithms, the methods and optimisation algorithms, the basics of intelligent computational methods, and programming techniques while using them. |

| Effect symbol | Teaching results | Teaching methods *(l/c/l/p/other)* | Reference to subject effects | Reference to effects of a field of study |
|---|---|---|---|---|
| W_01 | A student has fundamental knowledge as regards the methods and numerical optimisation algorithms as well as the fundamentals of intelligent computational methods useful in formulating and solving tasks connected with computer science. | l/l | K_W07, K_W16, K_W13 | T1A_W03, T1A_W04, T1A_W07 InżA_W02, InżA_W05 |
| W_02 | A student has systematised knowledge as regards the methodology and programming techniques using numerical and optimisation methods. | l/l | K_W07, K_W06, K_W16, | T1A_W03, T1A_W04, T1A_W07 InżA_W02, InżA_W05 |
| U_01 | A student is able to utilise the acquired mathematical knowledge to analyse and write algorithms as well as numerical methods. | l | K_U12, K_U13 | T1A_U08 T1A_U09 T1A_U13 T1A_U14 T1A_U15 T1A_U16 InzA_U01 InzA_U02 InzA_U05 InzA_U06 InzA_U07 InzA_U08 |
| U_02 | A student can utilise the learnt programming methodologies and techniques to create programs using numerical methods. | l | K_U12, K_U13 | T1A_U08 T1A_U09 T1A_U13 T1A_U14 T1A_U15 T1A_U16 InzA_U01 InzA_U02 InzA_U05 InzA_U06 InzA_U07 InzA_U08 |
| U_03 | A student can utilise the learnt methods and algorithms to build simple mathematical models. | l | K_U10, K_U13 | T1A_U08 T1A_U09 T1A_U10 T1A_U13 T1A_U14 T1A_U15 InzA_U02 InzA_U05 InzA_U06 InzA_U07 |
| K_01 | A student knows the examples and understands working information system based on numerical mathematical models. | l/l | K_K02 | T1A_K02 InzA_K01 |

## Teaching contents:

### Teaching contents as regards lectures

| Lecture number | Teaching contents | Reference to teaching results for a module |
|---|---|---|
| 1 | Number formats. Computer arithmetic. Floating-point arithmetic. Errors in computer computations. Error classification, error estimation. Horner scheme. | W_01, W_02 |
| 2 | Utilising polynomials in function interpolation. Interpolation with natural Lagrange's, and Newton's polynomials. Errors. Examples. | W_01, W_02 |
| 3 | Function approximation with polynomials. Errors. Examples. | W_01, W_02, K_01 |
| 4 | Numerical integration. Rectangle, trapezium, and Simpson's formulas. Errors. Examples. | W_01, W_02, K_01 |
| 5 | Numerical integration. Examples. | W_01, W_02 |
| 6 | Exact methods of solving systems of linear equations. Cramer's and Gauss' methods. Examples. | W_01, W_02 |
| 7 | Iterative methods of solving linear equations. Concurrence. Errors. Examples. | W_01, W_02 |
| 8 | Introduction to the methods of solving non-linear equations. Examples. | W_01, W_02 |
| 9 | The methods of solving ordinary differential equations. Examples. | W_01, W_02, K_01 |
| 10 | The methods of solving tasks concerning discrete optimisation. Examples. | W_01, W_02 |
| 11 | The methods of solving tasks concerning the optimisation of a one-dimensional function. Examples. | W_01, W_02 |
| 12 | Gradient methods of solving tasks concerning the optimisation of a multi-dimensional function. Examples. | W_01, W_02, K_01 |
| 13 | The fundamentals of intelligent computations. | W_01, K_01 |
| 14 | A classical genetic algorithm and its operation. | W_01 |
| 15 | The examples of applying computational methods in science and technology. | W_01, K_01 |

### Teaching contents as regards laboratory classes

| Laboratory class number | Teaching contents | Reference to teaching results for a module |
|---|---|---|
| 1 | Introduction. Familiarising students with the software. | W_01, W_02, U_01 |
| 2 | Error estimation and computation. Horner scheme. | W_02, U_01 |
| 3 | Function interpolation. | W_02, U_01, U_02, U_03 |
| 4 | Function approximation. | W_02, U_01, U_02, U_03 |
| 5 | Numerical integration. | W_02, U_01, U_02, U_03 |
| 6 | Numerical differentiation. | W_02, U_01, U_02, U_03 |
| 7 | Exact methods of solving systems of linear equations. Cramer's and Gauss' methods. | W_02, U_01, U_02, U_03 |
| 8 | Iterative methods of solving linear equations. | W_02, U_01, U_02, U_03 |
| 9 | Introduction to the methods of solving non-linear equations. | W_02, U_01, U_02, U_03 |
| 10 | The methods of solving ordinary differential equations. | W_01, W_02, U_01, U_02, U_03 |
| 11 | The methods of solving tasks concerning the optimisation of a one- | W_01, W_02, |

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| | dimensional function. | U_01, U_02, U_03 |
| 12 | The methods of solving tasks concerning the optimisation of a multi-dimensional function. | W_01, W_02, U_01, U_02, U_03 |
| 13 | Classical numerical optimisation methods. | W_01, W_02, U_01 |
| 14 | Intelligent computational methods – a genetic algorithm. | W_01, W_02, U_01 |
| 15 | Obtaining a credit for laboratory classes. | |

## The methods of assessing teaching results

| **Effect symbol** | **Methods of assessing teaching results**<br>*(assessment method, including skills – reference to a particular project, laboratory assignments, etc.)* |
|---|---|
| W_01 | An examination in the form of a test on the methods and numerical algorithms. |
| W_02 | An examination in the form of a test on encryption techniques, methods, and numerical algorithms. |
| U_01 | A test on the ability to analyse a task through determining the degree of its complexity; the selection of the method to be applied. |
| U_02 | A test on the ability to apply the acquired knowledge in order to solve particular tasks in which a student has to decide about the method used and the manner of using it. |
| U_02 | A test on the ability of encrypting a numerical method selected for a particular task. |
| K_01 | An examination. |

## STUDENT'S INPUT

| **ECTS credit points** | | |
|---|---|---|
| | **Type of student's activity** | **Student's workload** |
| 1 | Participation in lectures | **30** |
| 2 | Participation in classes | |
| 3 | Participation in laboratories | **30** |
| 4 | Participation in tutorials (2-3 times per semester) | **2** |
| 5 | Participation in project classes | |
| 6 | Project tutorials | |
| 7 | Participation in an examination | **2** |
| 8 | | |
| 9 | **Number of hours requiring a lecturer's assistance** | **64** *(sum)* |
| 10 | **Number of ECTS credit points which are allocated for assisted work** *(1 ECTS credit point=25-30 hours)* | **2.2** |
| 11 | Unassisted study of lecture subjects | **30** |
| 12 | Unassisted preparation for classes | |
| 13 | Unassisted preparation for tests | |
| 14 | Unassisted preparation for laboratories | **24** |
| 15 | Preparing reports | **20** |
| 16 | Preparing for a final laboratory test | **2** |
| 17 | Preparing a project or documentation | |
| 18 | Preparing for an examination | **5** |

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| 19 | Preparing questionnaires | |
| 20 | **Number of hours of a student's unassisted work** | **81** *(sum)* |
| 21 | **Number of ECTS credit points which a student receives for unassisted work** *(1 ECTS credit point=25-30 hours)* | **2.8** |
| 22 | **Total number of hours of a student's work** | **145** |
| 23 | **ECTS credit points per module** *1 ECTS credit point=25-30 hours* | **5** |
| 24 | **Work input connected with practical classes** *Total number of hours connected with practical classes* | **78** |
| 25 | **Number of ECTS credit points which a student receives for practical classes** *(1 ECTS credit point=25-30 hours)* | **2.69** |