#### card of course

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| Subject name | Foundations of Graph Theory |

1. The placement of the subject in the study system

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| 1.1. Field of study | Computer science |
| 1.2. Form and path of study | Full-time/Part-time |
| 1.3. Level of education | First-cycle studies |
| 1.4. Study profile | Practical |

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| 1.5. Specialty | - |
| 1.6. Subject Coordinator | Dr Kamil Powroźnik |

2. General characteristics of the subject

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| 2.1. Belonging to a subject group | Directional |
| 2.2. Number of ECTS | 1 |
| 2.3. Language of lectures | English |
| 2.4. Semesters in which the subject is taught | IV |
| 2.5.Criteria for selecting course participants | - |

1. Learning outcomes and course delivery
   1. Subject Objectives

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| No. | Subject Objectives |
|
| C1 | To introduce students to basic issues in graph theory. |
| C2 | To familiarize students with methods of creating and analyzing graphs. |
| C3 | Discussion of selected algorithms relating to graph theory. |
| C4 | Students acquire the ability to use graphs to solve various practical problems. |

* 1. Subject-specific learning outcomes, divided into knowledge , skills and competences , with reference to the directional learning outcomes

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| No. | Description of subject  learning outcomes | **Reference to directional effects**  **learning (symbols)** | Method of implementation (mark "X") | | | |
| ST | | NST | |
| Classes at the University | Activities on the platform | Classes at the University | Activities on the platform |
| After passing the course, the student knows and understands **the knowledge** | | | | | | |
| W1 | Basic definitions, issues and theorems in graph theory. | INF\_W02  INF\_W11 |  | X |  | X |
| W2 | Basic types and kinds of graphs. |  | X |  | X |
| W3 | The most important algorithms on graphs and their applications in various decision-making situations. |  | X |  | X |
| After passing the course, the student is **able** to: | | | | | | |
| U1 | Describe the concepts related to a graph and present it graphically. | INF\_U02  INF\_U08 |  | X |  | X |
| U2 | Solve elementary problems in graph theory and apply graph theory to practical problems |  | X |  | X |
| U3 | the student is able to construct theoretical models for a given problem in the form of a graph; analyze the decision-making problem, select appropriate structures for data representation and methods that facilitate finding the optimal solution to the decision-making problem |  | X |  | X |
| After completing the course, the student is ready to take part in **social competences.** | | | | | | |
| K1 | Independently update knowledge in the field of graph theory and critically evaluate the results of your own work. | INF\_K01 |  | X |  | X |

3.3. Forms of teaching and their number of hours - Full-time studies (ST), Part-time studies (NST)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Path | Lecture | Exercises | Design | Workshop | Laboratory | Seminar | Lecturer | Classes conducted using distance learning methods and techniques in the form of a lecture | Other | **ECTS points** |
| **ST** |  |  |  |  |  |  |  | 15 |  | 1 |
| **NST** |  |  |  |  |  |  |  | 10 |  | 1 |

3.4. Content of education (separately for each form of classes: (W, ĆW, PROJ, WAR, LAB, LEK, OTHER). It should be marked (X) how the given content will be implemented (classes at the university or classes on the e-learning platform conducted using distance learning methods and techniques)

TYPE OF CLASS: LECTURE

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| --- | --- | --- | --- | --- | --- | --- |
| No. | Content of the course | Reference to subject-specific learning outcomes | Method of implementation (mark "X") | | | |
| ST | | NST | |
| **Classes at the University** | **Activities on the platform** | **Classes at the University** | **Activities on the platform** |
| 1. | The concept of a graph and its components. Isomorphism, connectivity, neighborhood. Graphical and matrix representation of a graph. | W1, W2, U1, U2, U3, K1 |  | X |  | X |
| 2. | Paths and cycles. Euler cycle, Hamilton cycle. | W1, W2, U1, U2, U3, K1 |  | X |  | X |
| 3. | Trees. Properties of trees and their applications. Spanning trees. | W1, W2, U1, U2, U3, K1 |  | X |  | X |
| 4. | Planarity. Planar, dual, and infinite graphs. | W1, W2, U1, U2, U3, K1 |  | X |  | X |
| 5. | Coloring graphs. | W1, W2, U1, U2, U3, K1 |  | X |  | X |
| 6. | Selected algorithms in graph theory. | W3, U1, U2, U3, K1 |  | X |  | X |
| 7. | Summary of classes and discussion of grades |  |  | X |  | X |

3.5. Methods of verifying learning outcomes (indication and description of methods of conducting classes and verification of achievement of learning outcomes and method of documentation)

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| --- | --- | --- | --- |
| Subject Effects | Teaching methods | Methods of verifying learning outcomes | Documentation methods |
| KNOWLEDGE | | | |
| W1-W3 | Lecture in the form of a presentation enriched with numerous examples and applications relating to the issues discussed. | Written exam including theoretical and practical tasks verifying acquired knowledge, skills and competences | Exam sheet |
| SKILLS | | | |
| U1-U3 | Lecture in the form of a presentation enriched with numerous examples and applications relating to the issues discussed. | Written exam including theoretical and practical tasks verifying acquired knowledge, skills and competences | Exam sheet |
| SOCIAL COMPETENCES | | | |
| K1 | Lecture in the form of a presentation enriched with numerous examples and applications relating to the issues discussed. | Written exam including theoretical and practical tasks verifying acquired knowledge, skills and competences | Exam sheet |

3.6. Assessment criteria for the achieved learning outcomes

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| Learning effect | For a grade of 3 or "pass."  the student knows and understands/is able to/is ready to | For a grade of 3.5, the student knows and understands/is able to/is ready to | For a grade of 4, the student knows and understands/is able to/is ready to | For a grade of 4.5, the student knows and understands/is able to/is ready to | For a grade of 5, the student knows and understands/is able to/is ready to |
| W | 51-60% of knowledge indicated in learning outcomes | 61-70% of knowledge indicated in learning outcomes | 71-80% of knowledge indicated in learning outcomes | 81-90% of knowledge indicated in learning outcomes | 91-100% of knowledge indicated in learning outcomes |
| U | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |
| K | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |

3.7. Literature

**Basic**

1. Robinson Ian ; Webber Jim ; Eifrem Emil, Graph Databases. New Opportunities for Connected Data, O'Reilly Sebastopol, 2015

2. Wilson R. J., *Introduction do graph theory*, 5th edition, Pearson, Warszawa 2010

**Supplementary**

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Wprowadzenie do algorytmów*, PWN, Warszawa 2024

2. Sipser M., *Wprowadzenie do teorii obliczeń*, WNT, Warszawa 2020

4. Student workload - ECTS points balance

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| --- | --- | --- |
| **Types of student activity** | **Student Load** | |
| **ST** | **NST** |
| **Classes requiring direct contact between the student and the academic teacher at the university premises** | **15** | **10** |
| Classes included in the study plan | 15 | 10 |
| **Student's own work** | **10** | **15** |
| Ongoing preparation for classes, preparation of project work/presentations/etc. | 5 | 7 |
| Preparation for passing classes | 5 | 8 |
| **TOTAL STUDENT HOURLY LOAD** | **25** | **25** |
| **Number of ECTS points** | **1** | **1** |

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| Last change date | 30/09/2024 |
| The changes were introduced | INF Education Quality Team |
| The changes were approved | Arkadiusz Gwarda, M.A. |