COURSE DESCRIPTION CARD - SYLLABUS

Course name
Graph theory [S1MNT1>B-TG]

Course

Field of study
Mathematics of Modern Technologies

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

A student starting this course should have knowledge and skills in the courses Mathematical Analysis, Linear Algebra with Analytic Geometry, Mathematical Software, Programming, Information Technology. They should know the limitations of their own knowledge and understand the need for further education.

Course objective

Obtaining knowledge, skills and competences in the field of graph theory.

Course-related learning outcomes

Knowledge:
• knows and understands selected areas of mathematics to an advanced degree and has detailed knowledge of the applications of mathematical methods and tools in engineering and technical sciences [K_W01(P6S_WG)];
• knowsandunderstandstheconcepts,theoremsandmethodsformathematicalmodeling[K_W02(P6S_WG)];
• knows and understands issues in computer science, including numerical methods; knows at least one software package, programming language [K_W07(P6S_WG)].

Skills:
• can use knowledge of higher mathematics [K_U01(P6S_UW)];
• can build and analyze simple mathematical models [K_U02(P6S_UW)].

Social competences:
• is ready to critically assess the level of his/her knowledge in relation to research in exact and natural sciences as well as engineering and technical sciences [K_K01(P6S_KK)];
• is ready to deepen and expand knowledge to solve new technical problems [K_K02(P6S_KK)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: the knowledge acquired during the lecture is verified by a 45-minute colloquium;
Tutorials: control of the ability to use the knowledge provided during the lectures to solve tasks in the form of a colloquium;
Laboratory classes: the skills acquired during laboratory classes are verified on the basis of developed projects.

Programme content

Lectures, Tutorials and Laboratory classes:
• undirected graphs: depth-and-breadth search; shortest paths from a single source;
• directed graphs: single-source and multi-source reachability; paths directed from a single source; shortest paths directed from a single source; directed cycle detection; depth-first vertex orders; scheduling with priority constraints; topological sort;
• minimal spanning trees: Prim's algorithm; Kruskal's algorithm; Fredman-Tarjan algorithm;
• shortest path algorithms: Dijkstra; topological sorting; Bellman-Ford;
• algorithms for flow networks: Ford-Fulkerson algorithm for determining the maximum flow.

Course topics

Lectures, Tutorials and Laboratory classes:
• undirected graphs: depth-and-breadth search; shortest paths from a single source;
• directed graphs: single-source and multi-source reachability; paths directed from a single source; shortest paths directed from a single source; directed cycle detection; depth-first vertex orders; scheduling with priority constraints; topological sort;
• minimal spanning trees: Prim's algorithm; Kruskal's algorithm; Fredman-Tarjan algorithm;
• shortest path algorithms: Dijkstra; topological sorting; Bellman-Ford;
• algorithms for flow networks: Ford-Fulkerson algorithm for determining the maximum flow.

Teaching methods

Lectures: the lecture is conducted in an interactive way consisting in formulating questions addressed to a group of students and guiding them to the right line of reasoning. The message is illustrated with examples;
Tutorials: blackboard exercises involving the analysis and solving of sample tasks. Posing problems requiring the use of appropriate graph algorithms;
Laboratory classes: laboratory: Practical classes in the computer laboratory.

Bibliography

Basic:
• Sedgewick R., Wayne K., Algorytmy. Wydanie IV, Helion 2012;
• Heineman G., Nauka algorytmów: poradnik pisania lepszego kodu, Helion 2022;
• Wilson R. J., Wprowadzenie do teorii grafów, PWN, 2000.

Additional:
• Cormen T. H., Leiserson C. E., Rivest R. L., Stein C., Wprowadzenie do algorytmów [Introduction to Algorithms], PWN, Warszawa, 2018.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50