## COURSE PROGRAMME

### 1. Information about the programme

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|---|---|
| **1.1** University | **University "Alexandru Ioan Cuza" of Iasi** |
| **1.2** Faculty | **Faculty of Mathematics** |
| **1.3** Department | **Department of Mathematics** |
| **1.4** Domain | **Mathematics** |
| **1.5** Cycle | **Masters** |
| **1.6** Programme / Qualification | **Applied Mathematics** |

### 2. Information about the course

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|---|---|---|---|---|---|---|---|---|
| **2.1** Course Name | | | | Graph theory | | | | |
| **2.2** Course taught by | | | | Prof. PhD. MARIUS TARNAUCEANU | | | | |
| **2.3** Seminary / laboratory taught by | | | | Prof. PhD. MARIUS TARNAUCEANU | | | | |
| **2.4** Year | I | **2.5** Semester | I | **2.6** Type of evaluation[*] | E | **2.7** Course type[**] | | Ob |

[*]*E – Exam / C – Colloquium / V – Verification*
[**]*OB – Obligatory / OP – Optionally / F – Facultative*

### 3. Total hours (estimated per semester and activities)

| | | | | | |
|---|---|---|---|---|---|
| **3.1** Number of hours per week | 4 | **3.2** course | 2 | **3.3** seminary/ laboratory | 2 |
| **3.4** Total number of hours | 56 | **3.5** course | 28 | **3.6** seminary/ laboratory | 28 |

| Distribution | hours |
|---|---|
| Individual study using textbooks, course notes, bibliography items, etc. | 50 |
| Supplimentary study (library, on-line platforms, etc.) | 20 |
| Individual study for seminary/laboratory, homeworks, projects, etc. | 20 |
| Tutoring | 0 |
| Examination | 4 |
| Other activities | 0 |
| | |
| **3.7** Total hours of individual activity[*] | 94 |
| **3.8** Total hours per semester | 150 |
| **3.9** Credit points | 6 |

### 4. Pre-requisites - Curriculum (if necessary)

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| Completion of the following courses: "Logic and set theory", "Fundamental algebraic structures", "Arithmetics and Combinatorics". |

### 5. Conditions (if necessary)

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|---|---|
| **5.1** Course | Amphitheatre |
| **5.2** Seminary / Laboratory | Seminar room |

## 6. Objectives

General objective: The main goal of this course is to present some basic notions and results of graph theory. These will be use to develop algorithms and to write computer programs.

Specific objectives: Upon successful completion of this discipline, students will be able to:
- Describe and exemplify the fundamental notions of graph theory
- Apply the main studied results
- Use some theoretical results in solving problems
- Write computer programs based on algorithms

## 7. Specific competencies/Learning outcomes

• applies scientific methods
• teach mathematics
• teach digital literacy
• thinks abstractly
• finds solutions to problems

## 8. Contents

| 8.1 Course | Teaching methods | Remarks (number oh hours, references) |
|---|---|---|
| Graphs, digraphs, and generalizations | Exposition, conversation, demonstration | 2 hours |
| Methods of representing graphs and digraphs | Exposition, conversation, demonstration | 2 hours |
| Subgraphs and graph homomorphisms | Exposition, conversation, demonstration | 2 hours |
| Degrees. Indegrees and outdegrees | Exposition, conversation, demonstration | 2 hours |
| Paths, cycles, and circuits | Exposition, conversation, demonstration | 2 hours |
| Connectivity | Exposition, conversation, demonstration | 2 hours |
| Some important classes of graphs: complete graphs, planar graphs, bipartite graphs, regular graphs | Exposition, conversation, demonstration | 2 hours |
| Trees. Partial trees | Exposition, conversation, demonstration | 2 hours |
| Minimum cost trees. The algorithms of Kruskal and Prim | Exposition, conversation, demonstration | 2 hours |
| Counting problems for trees | Exposition, conversation, demonstration | 2 hours |
| Graph search algorithms | Exposition, conversation, demonstration | 2 hours |
| Shortest / longest path problems | Exposition, conversation, demonstration | 2 hours |
| The algorithms of Dantzig & Ford, Dijkstra,and Floyd & Warshall | Exposition, conversation, demonstration | 2 hours |
| The critical path method | Exposition, conversation, demonstration | 2 hours |

| **Bibliography** |
|---|
| Main references: |
| - Tărnăuceanu, M., "Introduction to graph theory", Ed. Matrix Rom, Bucureşti, 2025. |
| Other references: |
| - Smadici, C., "Introducere în analiza combinatorie", Ed. Matrix Rom, Bucureşti, 2007. |
| - Tomescu, I., "Introducere în combinatorică", Ed. Tehnică, Bucureşti, 1972. |

| 8.2 Seminary / Laboratory | Teaching methods | Remarks (number oh hours, references) |
|---|---|---|
| Graphs, digraphs, and generalizations | Exercise, conversation | 2 hours |
| Methods of representing graphs and digraphs | Exercise, conversation | 2 hours |
| Subgraphs and graph homomorphisms | Exercise, conversation | 2 hours |
| Degrees. Indegrees and outdegrees | Exercise, conversation | 2 hours |
| Paths, cycles, and circuits | Exercise, conversation | 2 hours |
| Connectivity | Exercise, conversation | 2 hours |
| Some important classes of graphs: complete graphs, planar graphs, bipartite graphs, regular grap | Exercise, conversation | 2 hours |
| Trees. Partial trees | Exercise, conversation | 2 hours |
| Minimum cost trees. The algorithms of Kruskal and Prim | Exercise, conversation | 2 hours |
| Counting problems for trees | Exercise, conversation | 2 hours |
| Graph search algorithms | Exercise, conversation | 2 hours |
| Shortest / longest path problems | Exercise, conversation | 2 hours |
| The algorithms of Dantzig & Ford, Dijkstra,and Floyd & Warshall | Exercise, conversation | 2 hours |
| The critical path method | Exercise, conversation | 2 hours |

**Bibliography**

Main references:
- Tărnăuceanu, M., "Introduction to graph theory", Ed. Matrix Rom, Bucureşti, 2025.

Other references:
- Tomescu, I., "Probleme de combinatorică şi teoria grafurilor", E.D.P., Bucureşti, 1981.

## 9. Coordination of the contents with the expectations of the community representatives, professional associations and relevant employers in the corresponding domain

The course presents some basic notions and results of graph theory. These are useful in all computer science jobs.

## 10. Assessment and examination

| 10.1 Continuous assessment | | Percentage (min. 30%) | 75 | | |
|---|---|---|---|---|---|
| Course | Assessment type | | Mixed assessment | | |
| | Percentage | | 50 | | |
| | Failure to pass the continuous assessment results in failure to pass the final assessment | | No | | |
| | Assessment methods | Details | Percentage | with reexamination | |
| | | Continuous written assessment | 50% | Yes | |
| | | Test | 30% | Yes | |
| | | Current assessment | 20% | No | |

| Seminary / Laboratory | Assessment type | | | Mixed assessment |
| --- | --- | --- | --- | --- |
| | Percentage | | | 50 |
| | Failure to pass the continuous assessment results in failure to pass the final assessment | | | No |
| | Assessment methods | Details | Percentage | with reexamination |
| | | Continuous written assessment | 50% | Yes |
| | | Test | 30% | Yes |
| | | Current assessment | 20% | No |

| **10.2 Final assessment** | Percentage (max. 70%) | 25 |
| --- | --- | --- |
| | Assessment type | Final mixed assessment |

| **10.3 Special notes (special situations is assessment)** | |
| --- | --- |
| The current assessment can be replaced with a report presentation. | |

| **10.4 Minimum performance standard** | |
| --- | --- |
| The final mark must be at least 5 | |

**Date,**      **Course coordinator,**      **Seminary coordinator,**
**Prof. PhD. MARIUS TARNAUCEANU**      **Prof. PhD. MARIUS TARNAUCEANU**


**Aproval date in the department,**      **Head of the departament,**
**Prof. PhD. IONEL DUMITREL GHIBA**