

# SYLLABUS

## 1. Information regarding the programme

|                                     |   |
|-------------------------------------|---|
| 1.1 Higher education institution    | Babes-Bolyai University                     |
| 1.2 Faculty                         | Faculty of Mathematics and Computer Science |
| 1.3 Department                      | Department of Mathematics                   |
| 1.4 Field of study                  | Mathematics                                 |
| 1.5 Study cycle                     | Bachelor                                    |
| 1.6 Study programme / Qualification | Mathematics-Computer Science                |

## 2. Information regarding the discipline

|                            |   |                                       |   |                         |   |                        |            |
|----------------------------|---|---------------------------------------|---|-------------------------|---|------------------------|------------|
| 2.1 Name of the discipline |   | Algebra 1 (Linear Algebra)            |   |                         |   |                        |            |
| 2.2 Course coordinator     |   | Assistant Professor PhD. Cosmin Pelea |   |                         |   |                        |            |
| 2.3 Seminar coordinator    |   | Assistant Professor PhD. Cosmin Pelea |   |                         |   |                        |            |
| 2.4. Year of study         | 1 | 2.5 Semester                          | 1 | 2.6. Type of evaluation | E | 2.7 Type of discipline | Compulsory |

## 3. Total estimated time (hours/semester of didactic activities)

|   |     |                      |    |                        |       |
|---|-----|----------------------|----|------------------------|-------|
| 3.1 Hours per week  | 4   | Of which: 3.2 course | 2  | 3.3 seminar/laboratory | 2     |
| 3.4 Total hours in the curriculum   | 56  | Of which: 3.5 course | 28 | 3.6 seminar/laboratory | 28    |
| Time allotment:   |     |                      |    |                        | hours |
| Learning using manual, course support, bibliography, course notes                     |     |                      |    |                        | 28    |
| Additional documentation (in libraries, on electronic platforms, field documentation) |     |                      |    |                        | 20    |
| Preparation for seminars/labs, homework, papers, portfolios and essays                |     |                      |    |                        | 28    |
| Tutorship   |     |                      |    |                        | 14    |
| Evaluations   |     |                      |    |                        | 4     |
| Other activities: .....   |     |                      |    |                        | -     |
| 3.7 Total individual study hours  | 94  |                      |    |                        |       |
| 3.8 Total hours per semester  | 150 |                      |    |                        |       |
| 3.9 Number of ECTS credits  | 6   |                      |    |                        |       |

## 4. Prerequisites (if necessary)

|                   |  |
|-------------------|--|
| 4.1. curriculum   |  |
| 4.2. competencies |  |

## 5. Conditions (if necessary)

|                                      |  |
|--------------------------------------|--|
| 5.1. for the course                  |  |
| 5.2. for the seminar /lab activities |  |

## 6. Specific competencies acquired

|                           |  |
|---------------------------|--|
| Professional competencies | C1.1 Identifying the notions, describing the theories and using the specific language<br><br>C2.3 Applying the adequate analytical theoretical methods to a given problem.   |
| Transversal competencies  | CT1. Applying some rules of precise and efficient work, showing a responsible attitude regarding the scientific domain and teaching training for an optimal and creative development of the personal potential in specific situations, respecting the deontological norms. |

## 7. Objectives of the discipline (outcome of the acquired competencies)

|  |  |
|--|--|
| 7.1 General objective of the discipline  | <input type="checkbox"/> To introduce the basic notions of linear algebra.   |
| 7.2 Specific objective of the discipline | <input type="checkbox"/> To introduce some basic results on vector spaces, matrices, systems of linear equations, eigenvalues, eigenvectors and quadratic forms. |

## 8. Content

| 8.1 Course                               | Teaching methods  | Remarks |
|--|---|---------|
| 1. Groups. Rings. Fields.                | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 2. Polynomial rings. Matrix rings        | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 3. Determinants. The inverse of a matrix | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |

|  |   |  |
|--|---|--|
| 4. The rank of a matrix. Systems of linear equations | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 5. Elementary operations on a matrix. Applications   | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 6. Vector spaces. Subspaces. The generated subspace  | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 7. Linear maps                                       | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 8. Test  |   |  |
| 9. Bases   | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 10. Dimension  | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 11. Matrices and linear maps                         | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 12. Eigenvectors and eigenvalues                     | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 13. Diagonalisable matrices. Hamilton-Cayley Theorem | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 14. Bilinear and quadratic forms.                    | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |

### Bibliography

1. R. COVACI, Algebra si programare liniara, Litografia UBB, Cluj-Napoca, 1986.
2. S. CRIVEI, Basic Abstract Algebra, Ed. Casa Cartii de Stiinta, Cluj-Napoca, 2002, 2003.
3. C. NASTASESCU, I. STANESCU, C. NITA, Matematica, Elemente de algebra superioara, Editura Didactica si Pedagogica, Bucuresti, 1995.

4. W. K. NICHOLSON, Linear Algebra and Applications, Lyryx Version,  
[https://lila1.lyryx.com/textbooks/OPEN\\_LAWA\\_1/marketing/Nicholson-OpenLAWA-2021A.pdf](https://lila1.lyryx.com/textbooks/OPEN_LAWA_1/marketing/Nicholson-OpenLAWA-2021A.pdf)  
 5. I. PURDEA, I. POP, Algebra, Editura GIL, Zalau, 2003.

| 8.2 Seminar / laboratory               | Teaching methods  | Remarks |
|--|---|---------|
| 1. Groups. Rings. Fields. Review.      | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 2. Determinants.                       | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 3. The rank of a matrix                | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 4. The inverse of a matrix             | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 5. Systems of linear equations         | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 6. Vector spaces.                      | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 7. Subspaces. Generated subspace       | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 8. Linear maps                         | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 9. Bases                               | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 10. Dimension formulas.                | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |
| 11. Dimension and generated subspaces. | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |         |

|  |   |  |
|--|---|--|
| 12. Matrices and linear maps   | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 13. Eigenvectors and eigenvalues. Diagonalisable matrices. Hamilton-Cayley Theorem | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |
| 14. Bilinear and quadratic forms.  | <input type="checkbox"/> Interactive exposure<br><input type="checkbox"/> Explanation<br><input type="checkbox"/> Conversation<br><input type="checkbox"/> Didactical demonstration |  |

### Bibliography

1. I.D. ION, N. RADU, Algebra (ed.4), Editura Didactica si Pedagogica, 1990.
2. I.D. ION, C. NITA, D. POPESCU, N. RADU: Probleme de algebra, Editura Didactica si Pedagogica, Bucuresti, 1981.
3. C. NASTASESCU, I. STANESCU, C. NITA, Matematica, Elemente de algebra superioara, Editura Didactica si Pedagogica, Bucuresti, 1995.
4. W. K. NICHOLSON, Linear Algebra and Applications, Lyryx Version,  
[https://lila1.lyryx.com/textbooks/OPEN\\_LAWA\\_1/marketing/Nicholson-OpenLAWA-2021A.pdf](https://lila1.lyryx.com/textbooks/OPEN_LAWA_1/marketing/Nicholson-OpenLAWA-2021A.pdf)
5. I. PURDEA, C. PELEA, Probleme de algebra, EIKON, Cluj-Napoca, 2008.

### 9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- ☐ The course presents notions which often appear in other undergraduate courses.
- ☐ The course offers a sufficiently general background for some highschool algebra topics and the opportunity to develop some problem solving skills useful for further teaching activities.

### 10. Evaluation

|                                     |                              |             |     |
|-------------------------------------|------------------------------|-------------|-----|
| 10.4 Course                         | Knowledge of basic concepts  | Test        | 25% |
|                                     | Knowledge of basic results   | Final exam. | 25% |
| 10.5 Seminar/laborator              | Examples and problem solving | Final exam. | 50% |
| 10.6 Minimum performance standards  |                              |             |     |
| The final grade must be at least 5. |                              |             |     |

|            |                                 |                                  |
|------------|---------------------------------|----------------------------------|
| Date       | Signature of course coordinator | Signature of seminar coordinator |
| 19.04.2022 | Assist. Prof. PhD. Cosmin Pelea | Assist. Prof. PhD. Cosmin Pelea  |

|                  |                                     |
|------------------|-------------------------------------|
| Date of approval | Signature of the head of department |
|                  | Prof.PhD. Octavian AGRATINI         |