**Content**

| Course Code | Course Name | Semester | Theory | Practice | Lab | Credit | ECTS |
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| ING207 | Linear Algebra | 3 | 2 | 2 | 0 | 3 | 5 |

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| Prerequisites | |
| Admission Requirements | |

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| Language of Instruction | French |
| Course Type | Compulsory |
| Course Level | Bachelor Degree |
| Objective | Mathematical problems such as solving systems<br>linear differentials (which occur in many areas<br>physics such as mechanics or electronics) or analysis in<br>principal components in statistics use the diagonalization of<br>square matrices. Determine if a matrix is ??diagonalizable, and in<br>in this case, diagonalizing it is therefore the key to this course.<br>In this context, the objectives of this course are:<br>• Explain to students how the determinant of a matrix is<br>defined using permutations and their signature, in particular<br>in order to be able to define the characteristic polynomial.<br>• Teach students to determine the specific elements of a<br>matrix.<br>• Demonstrate to the students the conditions of diagonalization of a<br>matrix.<br>• Explain to the students how to use diagonalization to<br>solve linear systems. |
| Content | 1. Symmetric group: decomposition into products and signature of a permutation<br>2. Determinants: definition, properties and calculation rules<br>3. Determinants: determinants of "small" dimensions, classical determinants<br>4. Diagonalization: Introduction and first examples<br>5. Classical determinant applications<br>6. Diagonalization: criterion of diagonalization (case of multiple eigenvalues)<br>7. Diagonalization: diagonalization of "small" dimension matrices<br>8. Partial Examination<br>9. Diagonalization: calculation of the nth powers of a diagonalizable matrix<br>10. Polynomials of matrices, canceling polynomials - Cayleigh Hamilton Theorem<br>11. Application to the calculation of the nth powers of a matrix (diagonalizable or not)<br>12. Application to linear recurrent sequences<br>13. Application to differential systems (diagonalizable case)<br>14. Practical studies |
| References | 1. Lectures notes ans worksheets<br>2. http://braise.univ-rennes1.fr/braise.cgi<br>3. http://www.unisciel.fr |

**Theory Topics**

| Week | Weekly Contents |
|---|---|
| 1 | The grup of permutations. |
| 2 | Decomposition into disjoint cycles, decomposition into transposition and signature of a permutation. |
| 3 | Determinant : definition and basic propoerties |
| 4 | Some methods to compute determinant |
| 5 | Some examples of classic determinants. |
| 6 | eigenvalues of a determinant and some geometric examples. |
| 7 | Characteristic polynomial, eigenvalues and eigenvectors |
| 8 | Diagonalizable matrixs |

| Week | Weekly Contents |
|---|---|
| 9 | Midterm exam |
| 10 | The Cayley–Hamilton theorem |
| 11 | Different methods for computing the powers of a matrix. |
| 12 | Linear recurrence sequences of order 2 or 3. |
| 13 | Systems of homogeneous linear differential equations with constant coefficients. |
| 14 | Systems of nonhomogeneous linear differential equations with constant coefficients. |