# ALGEBRAIC NUMBER THEORY I

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| 1 | Course Title: | ALGEBRAIC NUMBER THEORY I | |
| 2 | Course Code: | MAT5207 | |
| 3 | Type of Course: | Optional | |
| 4 | Level of Course: | Second Cycle | |
| 5 | Year of Study: | 1 | |
| 6 | Semester: | 1 | |
| 7 | ECTS Credits Allocated: | 6.00 | |
| 8 | Theoretical (hour/week): | 3.00 | |
| 9 | Practice (hour/week): | 0.00 | |
| 10 | Laboratory (hour/week): | 0 | |
| 11 | Prerequisites: | none | |
| 12 | Language: | Turkish | |
| 13 | Mode of Delivery: | Face to face | |
| 14 | Course Coordinator: | Prof. Dr. İSMAİL NACİ CANGÜL | |
| 15 | Course Lecturers: | Prof. Dr. Osman BİZİM | |
| 16 | Contact information of the Course Coordinator: | Uludağ Üniversitesi, Fen-Edebiyat Fakültesi<br>Matematik Bölümü, Görükle Bursa-TÜRKİYE 0 224 294 17 57 / obizim@uludag.edu.tr | |
| 17 | Website: | | |
| 18 | Objective of the Course: | The aim of this lecture is to illustrate how basic notions from the theory of algebraic numbers may be used to solve problems in number theory. The main focus is to extend properties of the integer numbers to more general number structures: algebraic number fields and their rings of algebraic integers. So students can So students have the ability conduct original research and independent publication. | |
| 19 | Contribution of the Course to Professional Development: | | |
| 20 | Learning Outcomes: | | |
| | | **1** | Learns the concepts, integral domains, irreducibles and primes in an integral domain. |
| | | **2** | Learns Euclidean domains, examples of Euclidean domains, Noetherian domains, çarpanlara ayırma bölgeleri, unique factorization domains. |
| | | **3** | Learns algebraic extensions of a field, conjugate elements, algebraic integers in a quadratic field, simple extensions. |
| | | **4** | Learns algebraic number fields, conjugate fields of an algebraic number field, prime ideals in rings of integers. |
| | | **5** | Learns class groups and and some class number calculations. |
| | | **6** | Learns ideal class group and Minkowski theorem. |
| | | **7** | Uses algebraic number theory to solve some Diophantine equations. |
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| 21 | Course Content: | | |
| | **Course Content:** | | |

| Week | Theoretical | Practice |
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| **1** | Integral domains, irreducibles and primes in an integral domain. | |
| **2** | Ideals, principal ideal domains, maximal and prime ideals, sums and products of ideals. | |
| **3** | Euclidean domains, examples of Euclidean domains, almost Euclidean domain. | |
| **4** | Noetherian domains, çarpanlara ayırma bölgeleri, unique factorization domains, modules, Noetherian modules. | |
| **5** | Algebraic numbers, algebraic integers, closure. | |
| **6** | Algebraic extensions of a field, conju-gate elements, algebraic integers in a quadratic field, simple extensions. | |
| **7** | Algebraic number fields, conjugate fields of an algebraic number field, prime ideals in rings of integers. | |
| **8** | Dedekind domains, ideals in Dedekind domains and generator of an ideal. | |
| **9** | Norm of an ideal, norm and trace of an element, norm of a product of ideals | |
| **10** | Norm of a prime ideal, factoring in quadratic number fields, factoring in cyclotomic fields. | |
| **11** | Units in quadratic fields, the fundamental unit, calculating the fundamental unit. | |
| **12** | Class groups and and some class number calculations. | |
| **13** | The ideal class group and Minkowski theorem. | |
| **14** | Applications to Diophantine equations and some examples. | |

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| **22** | Textbooks, References and/or Other Materials: | [1]Algebraic Number Theory and Fermat's Last Theorem, Ian Stewart, David Tall.<br>[2] Algebraic Number Theory, J. Neukirch.<br>[3]Introductory Algebraic Number Theory, Ş. Alaca, K.S. Williams.<br>[4]Algebraic Numbers, Paulo Ribenboim. |
| **23** | Assesment | |

| **TERM LEARNING ACTIVITIES** | **NUMBER** | **WEIGHT** |
|---|---|---|
| Midterm Exam | 0 | 0.00 |
| Quiz | 0 | 0.00 |
| Home work-project | 0 | 0.00 |
| Final Exam | 1 | 100.00 |
| Total | 1 | 100.00 |
| Contribution of Term (Year) Learning Activities to Success Grade | | 0.00 |
| Contribution of Final Exam to Success Grade | | 100.00 |
| Total | | 100.00 |
| Measurement and Evaluation Techniques Used in the Course | | |

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| **24** | **ECTS / WORK LOAD TABLE** |

| Activites | Number | Duration (hour) | Total Work Load (hour) |
|---|---|---|---|
| Theoretical | 14 | 3.00 | 42.00 |
| Practicals/Labs | 0 | 0.00 | 0.00 |
| Self study and preperation | 14 | 5.00 | 70.00 |
| Homeworks | 0 | 0.00 | 0.00 |
| Projects | 0 | 0.00 | 0.00 |
| Field Studies | 0 | 0.00 | 0.00 |
| Midterm exams | 0 | 0.00 | 0.00 |
| Others | 14 | 5.00 | 70.00 |
| Final Exams | 1 | 43.00 | 43.00 |
| Total Work Load | | | 225.00 |
| Total work load/ 30 hr | | | 7.50 |
| ECTS Credit of the Course | | | 6.00 |

| 25 | CONTRIBUTION OF LEARNING OUTCOMES TO PROGRAMME QUALIFICATIONS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PQ1** | **PQ2** | **PQ3** | **PQ4** | **PQ5** | **PQ6** | **PQ7** | **PQ8** | **PQ9** | **PQ10** | **PQ11** | **PQ12** | **PQ13** | **PQ14** | **PQ15** | **PQ16** |
| **ÖK1** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK2** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK3** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK4** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK5** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK6** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK7** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **LO: Learning Objectives PQ: Program Qualifications** | | | | | | | | | | | | | | | | |
| **Contribution Level:** | **1 very low** | | **2 low** | | | **3 Medium** | | | **4 High** | | | **5 Very High** | | | | |