

DEPARTMENT OF ROBOTICS AND INTELLIGENT SYSTEMS ENGINEERING

| Course Details | | | | | |
|---|---|----------|-----------------|----------------------|---------------------|
| Code | | | | Academic Year | Semester |
| RIS51 | | | | 1 | 1 |
| Title | T | A | L | ECTS | |
| Quantum Computation and Quantum Information | 2 | 1 | 2 | 7 | |
| Language | | | | | |
| Language | English | | | | |
| Level | | | | | |
| Level | Undergraduate | | Graduate | X | Postgraduate |
| Department / Program | | | | | |
| Department / Program | Robotics and Intelligent Systems | | | | |
| Forms of Teaching and Learning | | | | | |
| Forms of Teaching and Learning | Formal Teaching | | | | |
| Course Type | | | | | |
| Course Type | Compulsory | | Elective | X | |
| Objectives | | | | | |
| Objectives | The main objectives of this modul are to introduce students necessary parts of quantum physics for quantum computation and quantum information and provide students basic knowledge of quantum information and quantum computation which are necessary for construction and usage of quantum computers. | | | | |
| Content | | | | | |
| Content | <ul style="list-style-type: none"> • A general introduction to information theory • Qubits and Quantum States • Quantum Measurement Theory • Entanglement • Quantum Gates and Quantum Circuits • Quantum Algorithms | | | | |
| Prerequisites | | | | | |
| Prerequisites | | | | | |
| Coordinator | | | | | |
| Coordinator | | | | | |
| Lecturer(s) | | | | | |
| Lecturer(s) | Assoc. Prof. Dr. Haydar UNCU | | | | |
| Assistant(s) | | | | | |
| Assistant(s) | | | | | |
| Work Placement | | | | | |
| Work Placement | | | | | |
| Recommended or Required Reading | | | | | |
| Books / Lecture Notes | | | | | |
| Books / Lecture Notes | <ul style="list-style-type: none"> • McMahon, D. (2008). Quantum Computing (Explained), Wiley-Interscience. • Nielsen, M.A., Chuang I.L. (2010). Quantum Computation and Quantum Information, (10th Anniversary Edition). Cambridge University Press. • Barnett, S.M. (2009). Quantum Information (1st Edition), Cambridge University Press. • Huggs, C., Isaacson J., Perry, A., Ranbell, S.F., Turner J., (2021), Springer Velag. | | | | |
| Other Sources | | | | | |
| Other Sources | | | | | |
| Additional Course Material | | | | | |
| Documents | | | | | |
| Documents | | | | | |

DEPARTMENT OF ROBOTICS AND INTELLIGENT SYSTEMS ENGINEERING

| | | | |
|------------------------------------|--------------|-----------------------|--------------------------|
| Assignments | | | |
| Exams | | | |
| Course Composition | | | |
| Mathematics und Basic Sciences | | %40 | |
| Engineering | | %20 | |
| Engineering Design | | %10 | |
| Social Sciences | | % | |
| Educational Sciences | | % | |
| Natural Sciences | | %30 | |
| Health Sciences | | % | |
| Expert Knowledge | | % | |
| Assessment | | | |
| Activity | Count | Percentage (%) | |
| Midterm Exam | 1 | 50 | |
| Quiz | | | |
| Assignments | | 10 | |
| Attendance | | | |
| Recitations | | | |
| Projects | | | |
| Final Exam | 1 | 40 | |
| | Total | 100 | |
| ECTS Points and Work Load | | | |
| Activity | Count | Duration | Work Load (Hours) |
| Lectures | 14 | 3 | 42 |
| Self-Study | 14 | 9 | 126 |
| Assignments | 5 | 5 | 25 |
| Presentation / Seminar Preparation | | | |
| Midterm Exam | 1 | 2 | 2 |
| Recitations | | | |
| Laboratory | | | |

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|---|---|---|------------|
| Projects | | | |
| Final Exam | 1 | 2 | 2 |
| Total Work Load | | | 197 |
| ECTS Points (Total Work Load / Hour) | | | 7 |

Learning Outcomes

| | |
|----|--|
| 1 | Should be familiar with necessary knowledge of quantum physics for quantum information and quantum computation |
| 2 | Should explain mathematical definition of information |
| 3 | Should be able to explain what entanglement is |
| 4 | Should be able to use basic quantum computational methods |
| 5 | Should be able to explain functions of quantum gates and their usage in quantum circuits |
| 6 | Should be able to explain functions of simple quantum circuits |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |

Weekly Content

| | |
|----|---|
| 1 | Introduction to Quantum Computation and Quantum Information |
| 2 | Qubits and Quantum States |
| 3 | Qubits and Quantum States |
| 4 | Matrices and Operators |
| 5 | Density Operators |
| 6 | Density Operators |
| 7 | Quantum Measurement Theory |
| 8 | Midterm Exam |
| 9 | Quantum Measurement Theory |
| 10 | Entanglement |
| 11 | Entanglement |
| 12 | Quantum Gates |
| 13 | Quantum Gates |

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|--|------------------|---|-----------|-----------|-----------|-----------|-----------|
| 14 | Quantum Circuits | | | | | | |
| 15 | Quantum Circuits | | | | | | |
| Contribution of Learning Outcomes to Program Objectives (1-5) | | | | | | | |
| | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
| 1 | 5 | 5 | 5 | | | | |
| 2 | 5 | 3 | 3 | | | | |
| 3 | 5 | 4 | 4 | | | | |
| 4 | 5 | 5 | 5 | | | | |
| 5 | 3 | 5 | 5 | | | | |
| 6 | 5 | 5 | 5 | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| Contribution Level | | 1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High | | | | | |
| Compiled by: | | Assoc. Prof. Haydar Uncu | | | | | |
| Date of Compilation: | | 17.06.2022 | | | | | |