# uc3m

| COURSE: INTRODUCTION TO QUANTUM COMMUNICATIONS AND COMPUTING | | |
|---|---|---|
| **DEGREE: GICME, GISI, GITT, GIT** | **YEAR: 4th** | **TERM: 2nd** |

| COURSE PLANNING | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **WEEK** | **SESSION** | **DESCRIPTION** | **GROUP** | | **Indicate if a different lecture room is needed** | **SESSION WITH 2 LECTURERS** | **STUDENT'S WORK** | | |
| | | | LARGE | SMALL | | | DESCRIPTION | CLASS HOURS | OUT-OF-CLASS WORK HOURS |
| | | | | | | | | | |
| 1 | 1 | **Unit 1. Introduction: bits versus qubits**<br>- What is a qubit?<br>- Course outline | | X | | NO | Recommended reading | 1,66 | 3 |
| 2 | 2 | **Unit 1. Introduction: bits versus qubits**<br>- Probability theory<br>- Bell theorem | | X | | NO | Mathematical background in probability theory | 1,66 | 4 |
| 3 | 3 | **Unit 2. Axioms of quantum mechanics**<br>- Principles of quantum mechanics<br>- Quantum states and measurements | | X | | NO | Mathematical background in linear algebra | 1,66 | 4 |
| 4 | 4 | **Unit 2. Axioms of quantum mechanics**<br>- Combining systems: quantum entanglement | | X | | NO | Homework exercises | 1,66 | 4 |
| 5 | 5 | **Unit 2. Axioms of quantum mechanics**<br>- Temporal evolution of a system | | X | | NO | Homework exercises | 1,66 | 4 |
| 6 | 6 | **Unit 2. Axioms of quantum mechanics**<br>- Simulation experiment: Bell inequality | | X | | NO | Solve the practical assignment | 1,66 | 4 |
| 7 | 7 | **Unit 3. Quantum communications**<br>- Transmission of information<br>- Modeling quantum channels | | X | | NO | Review theory | 1,66 | 4 |
| 8 | 8 | **Unit 3. Quantum communications**<br>- Unitary non-local resources and protocols<br>- Superdense coding and teleportation | | X | | NO | Homework exercises | 1,66 | 4 |
| 9 | 9 | **Unit 3. Quantum communications**<br>- Quantum cryptography | | X | | NO | Homework exercises | 1,66 | 4 |
| 10 | 10 | **Unit 3. Quantum communications**<br>- Lab: Secure link Alice-Bob-Eve | | X | | NO | Solve the practical assignment | 1,66 | 4 |

| | | | | X | | NO | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 11 | **Unit 4. Quantum computing**<br>- Quantum computers<br>- Quantum gates and circuits | | X | | NO | Recommended reading | | 1,66 | 4 |
| 12 | 12 | **Unit 4. Quantum computing**<br>- Quantum algorithms | | X | | NO | Solve the practical assignment | | 1,66 | 4 |
| 13 | 13 | **Unit 4. Quantum computing**<br>- Grover's algorithm | | X | | NO | Solve the practical assignment | | 1,66 | 4 |
| 14 | 14 | **Unit 4. Quantum computing**<br>- Present and future of the technology | | X | | NO | Recommended reading | | 1,66 | 4 |
| | | | | | | | | **Subtotal 1** | **23,33** | **55** |
| | | **Total 1** *(Hours of student work in weeks 1-14)* | | | | | | | **78,33** | |
| 15 | | Session recovery, tutor sessions, report deliveries… | | | | | | | 1,66 | 10 |
| | | | | | | | | **Subtotal 2** | **1,66** | **10** |
| | | **Total 2** *((Hours of student work in weeks 15-18)* | | | | | | | **11,66** | |
| **TOTAL** *(Total 1 + Total 2)* | | | | | | | | | **90** | |