



ORGANIZATION (art. 3 del D.R. n. 915/2018)
INTERNATIONAL MASTER IN CO₂ Geological Storage

Art. 1 – General Information

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| Proposing Department /Managing Department | <i>Earth Science Department</i> |
| Reference Faculty | <i>Mathematics, Physics and Natural Science Faculty</i> |
| Name of the Master | <i>International Master in “CO₂ Geological Storage”</i> |
| Level | <i>II level</i> |
| Type of title | <i>Joint title (one document signed by the two Rectors)</i> |
| Approval of the Reference Dep. Council for the establishment of the Master | <i>Approval of the Earth Science Dep. on the 23rd of May 2018 Approved with modification on.....</i> |
| Partner University | <i>University of Zagreb, Faculty of Mining, geology and Petroleum Engineering</i> |

Art. 2 – Educational information

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| Educational purpose of the Master | The goal of the course is to provide the participants with the scientific and technical knowledge that needs to be addressed for the successful storage of CO ₂ into geological |
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| | <p>formations. The programme will cover all aspects of the geological storage of CO₂ so that the students can both understand the work of all specialists who will be involved in CCS projects (such as reservoir engineers/geologists, sedimentologists, stratigraphers, geophysicists, structural geologists, geochemical modellers, regulators, etc.) and further develop their own field of specialization.</p> <p>The course is aimed at individuals interested in developing a solid professionalism in the field of geological storage of CO₂. In fact, Carbon Capture and Storage (CCS) is a rapidly advancing field with many interdisciplinary scientific and technical challenges that are being addressed globally.</p> <p>This course is provided within the EU project ENOS (Enabling Onshore CO₂ Storage in Europe) to prepare a new generation of young people who want to work on these topics. This training course will present an overview of the state-of-the-art of CCS operations and research; it will focus on the technical and scientific considerations for CO₂ injection and safety monitoring, the exploration of critical processes in laboratory studies, and numerical modelling.</p> |
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| Expected educational outcomes | <p>After completing the master, the student will be able to:</p> <ul style="list-style-type: none">Ø Describe the influence of anthropogenic emissions of CO₂ on climate change (and compare it with influence of other GHG on climate)Ø Define and explain all relevant segments of CCS process chainØ Enumerate all possible options for geological storage of CO₂ and explain mechanisms that enable retention of CO₂ in different types of underground storagesØ Explain geochemical interactions in reservoir (between injected CO₂, pore fluids and reservoir rocks) as well as in cap-rock (between injected CO₂, pore fluids and cap-rocks)Ø Explain basic terms from reservoir engineeringØ Explain the process of enhanced oil recovery using CO₂ and how the CO₂EOR process can be optimized to maximize the retention of CO₂ in the reservoirØ Perform initial screening of a sedimentary basin for possible CO₂ underground storage sitesØ Estimate (Calculate) static capacity for CO₂ geological storage of deep saline aquifer and depleted HC reservoirØ Describe the workflow of dynamic CO₂ storage capacity estimationsØ Enumerate and explain all possible risks of CO₂ geological storage and define appropriate mitigation measuresØ Enumerate monitoring techniques and explain when and how each of the monitoring techniques should be applied. |
| SSD (Italian education organization) | <i>Geo/03, Geo/11, Geo/06, Geo/08 ING-IND24, ING-IND25, ING-IND30, ING-IND35</i> |



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| Requirements for admission | The Master is dedicated to candidates having a Master degree (5 years) in Earth Sciences according to the European educational system. Persons that have a degree issued by non EU universities can be admitted to the course in the case that the Scientific and Educational Council recognizes it as sufficient for admission. Non EU university academic degrees, will be considered for admission according to the internal regulation of each University. Sapienza requires the Declaration of Value issued by the competent diplomatic or consular offices of the country where the title was obtained. |
| Number of students | <i>minimum 8; maximum 10</i> |
| Selection for admission | <i>Selection by titles</i> |
| Starting and ending dates (approx) | <i>Do define on the base of the date of the call</i> |
| External students | <i>Yes</i> |
| Attendance | <i>The attendance of at least the 80% of the lessons is mandatory.</i> |
| Traineeship offers | University of Zagreb, Croatia Iris, Norvegia; GEUS, Danimarca; HWU, Scotland, Nottingham University, Scotland; Tallinn University, Estonia (Partners ENOS Project) |
| Final exams | <i>Defence of the report on the results of the two months work</i> |
| language | <i>English</i> |

**Art. 3 – Teaching activities**

| Denominazione attività formativa | SSD | CFU |
|--|-------------------|---------------|
| Module 1 - Introduction to CO ₂ geological storage - Social aspect | Geo/03 | 3 |
| Module 2 - CO ₂ Capture and transport. Present day industrial utilization of CO ₂ | ING-IND 24 | 1,5 |
| | ING-IND 25 | 1,5 |
| Module 3 - Introduction to exploration geophysics | Geo/03 | 1 |
| | Geo/11 | 2 |
| Module 4 - CO ₂ geological storage options - geology and geochemistry | Geo/03 | 1 |
| | Geo/06 | 1 |
| | Geo/08 | 1 |
| Module 5 - Introduction to reservoir engineering | Geo/03 | 1 |
| | ING-IND 30 | 2 |
| Module 6 - Storage site selection and capacity estimates | Geo/03 | 3 |
| Module 7 - Numerical modelling of CO ₂ storage | Geo/03 | 1 |
| | ING-IND 30 | 2 |
| Module 8 - EOR with CO ₂ | ING-IND 30 | 3 |
| Module 9 - Storage Risks | Geo/03 | 2 |
| Module 10 - Geophysical monitoring | Geo/11 | 5 |
| Module 11 - Geochemical monitoring | Geo/08 | 3 |
| Module 12 - Drilling and wells | ING-IND 30 | 2 |
| Module 13 - Economic and Regulatory aspects of CCS technology | ING-IND 35 | 1 |
| Module 14 - CCUS and cross-cutting issues | Geo/03 | 1 |
| | Geo/08 | 2 |
| Esercitazione di gruppo | | 5 |
| Lavoro di tesi individuale presso una delle università o enti di ricerca partner del progetto e discussione finale | | 15 |
| totale | | 60 CFU |

Art. 4 – Organization



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| Locations | <i>1 classroom Computer lab (about 10 days)</i> |
| Tecnical-administrative personnel | <i>1 person</i> |
| Tutor | <i>0</i> |
| Teaching resources | <i>5 professors from Sapienza University, 3 professors from Zagreb University, 1 professor from HWU, 1 professor from GEUS, 1 professor from University of Nottingham, 1 professor from Tallinn University of Technology.</i> |
| Hosting University | <i>Sapienza University, Zagreb University</i> |
| Hosting Departments/Faculty | <i>Dipartimento Scienze della Terra (first cycle), Faculty of Mining, Geology and Petroleum Engineering (second cycle)</i> |

Art. 5 – Fonds/fee

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| Student Fee | |
| I rate | €1000 |
| II rate | To define |
| Fee reductions | <i>Not provided</i> |
| External financial support | <i>No</i> |
| Financial support from other source (research projects) | <i>€ 5000 from ENOS for student mobility or fee reduction</i> |