

**19. SPECIALIST IN OPTIMIZATION AND DEVELOPMENT OF MRI EQUIPMENT, SEQUENCES AND STUDY TECHNIQUES<sup>i</sup>**

Level I

**Department of Experimental and Clinical Biomedical Sciences "Mario Serio"**

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| <b>Executive Committee</b>  | Linda Calistri<br>Enrico Fainardi<br>Stefano Chiti<br>Giacomo Belli  |
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| <b>Practical-professional profile of the course and industry sector of reference</b>                  | <p>This Master Course grew out of a desire to provide in-depth knowledge in magnetic resonance imaging at a high level and from the initial experiences of an advanced training course taught in a hospital setting. Nowadays, the Master Course offers highly specialized postgraduate training in Magnetic Resonance Imaging in the technical field thanks to a pathway that, starting from the physical basics, leads to the systematic study of the sequences and the associated parameters. Constant attention is paid to technological evolutions. Lectures, grouped by modules, are given by radiology technician faculty for a description of sequences and in-depth study techniques by district, by medical physicists for physical principles of MRI imaging, and by radiology physicians for discussion of the technical conduct of an examination and by engineers for some technical lectures.</p> <p>A part of the internship is also planned at the facility hosting the Master (Careggi University Hospital), a hospital where third-level diagnostic examinations are performed, thus allowing students to benefit from the opportunity to attend highly specialized 2nd and 3rd level examinations. The course content also includes cooperation with leading MRI equipment manufacturers to explain the most important technological innovations introduced to the market.</p> <p>The title of "Magnetic Resonance Imaging Specialist," which is also included in the new labor contract as part of the sector of new positions linked to the acquisition of professional master qualifications, can be leveraged in various work contexts, mainly in hospitals (both public and private) but also as an application specialist at most major MRI equipment manufacturers both in Italy and abroad.</p> <p>To this end, training will be structured as follows:</p> <p><b>Module 1. Introductory elements of mathematics, statistics, physics, and computer science</b></p> <ul style="list-style-type: none"> <li>- Basic mathematics</li> <li>- Statistics</li> <li>- Elements of computer science in medical imaging</li> <li>- Elements of MRI physics</li> <li>- Signal theory</li> </ul> <p><b>Module 2. Physics, instrumentation/technology and safety in magnetic resonance imaging</b></p> <ul style="list-style-type: none"> <li>- Physics of MR imaging</li> <li>- Safety in MRI</li> </ul> <p><b>Module 3. Techniques and technologies of applied MRI</b></p> <ul style="list-style-type: none"> <li>- Characteristics of the matrix</li> <li>- The MR image</li> <li>- K-space (<i>filling trajectories</i>)</li> </ul> |

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|  | <ul style="list-style-type: none"> <li>- Time diagrams</li> <li>- K-Space vs. Image-Space</li> <li>- Image acquisition techniques</li> <li>- Scanning parameters</li> <li>- Contrast</li> <li>- Saturation techniques</li> <li>- Artifacts</li> <li>- Pulse sequences</li> <li>- Technological developments and innovations</li> <li>- Advanced Applications</li> </ul> <p><b>Module 4. Magnetic resonance imaging procedures and quality</b></p> <ul style="list-style-type: none"> <li>- Pharmacology Contrast media used in MRI studies</li> <li>- Procedures in MRI Imaging</li> <li>- Clinical practice and patient management</li> <li>- Anatomical sections and study techniques</li> <li>- Clinical conduct of an MRI examination</li> <li>- Ethics and laws in imaging sciences</li> </ul> <p><b>Bibliography.</b><br/> Magnetic Resonance Curriculum_2015<br/> <i>©Copyright 2015 American Society of Radiologic Technologists, the Association of Educators in Imaging and Radiologic Sciences, and the Section for Magnetic Resonance Technologists of the International Society for Magnetic Resonance in Medicine. All rights reserved.</i></p> <p>At the end of the course, learners will have acquired the following knowledge and skills:</p> <ul style="list-style-type: none"> <li>• Perform their activities independently, on the clinical indications of the Radiology Physician; evaluate and optimize protocols for performing examinations on specific MRI equipment and performing post-processing procedures agreed upon with the Radiology Physician and the Health Physicist;</li> <li>• Manage the technical aspects and takeover of the MRI site in the specialized area in question; be the contact person for equipment maintenance technicians. Collaborate with the Health Physics Unit for quality controls of equipment and new technologies implemented currently and in the future.</li> <li>• Take charge of training and disseminate their acquired knowledge among colleagues. Provide training and shadowing on the MRI equipment to other colleagues so that they are trained in the acquisition, execution, and post-processing of the required procedures; to be a point of reference for new hires and undergraduate learners approaching the method.</li> <li>• Actively participate in training and research projects in collaboration with colleagues, external agencies, and professionals, particularly University institutions.</li> <li>• To develop and expand the knowledge acquired during the Master Course with the latest applications (software - techniques) considering the continuous technological evolution, to update one's and the team's skills.</li> </ul> |
| <b>Access prerequisites</b>                    | Bachelor's degree obtained in accordance with ex-Ministerial Decree No. 270/2004 (or ex-Ministerial Decree No. 509/1999 equated pursuant to I.D. July 9, 2009) in Medical Radiology Imaging and Radiotherapy Techniques in the L/SNT3 Class of degrees in technical health professions or equivalent degree pursuant to Law No. 1/2002, provided it is combined with a high school diploma   |
| <b>How the admission procedure takes place</b> | Selection by qualifications combined with test, aimed at verifying knowledge on the MRI.<br>The test will consist of a multiple-choice test (only on MR).  |
| <b>Duration</b>                                | 10 months  |

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| <b>Teaching methods</b>                     | Blended mode (the platforms for the distance learning part will be Cisco Webwex Meeting and Google Meet)  |
| <b>Language of instruction</b>              | Italian   |
| <b>Attendance requirements</b>              | 75% of classroom lectures 75% of internship   |
| <b>Location of the course</b>               | CDM classrooms, NIC Careggi classrooms  |
| <b>Foreseen lecture schedule</b>            | Classes are held in 3-day slots (rarely 4 days in case of make-ups) on Mondays, Tuesdays, and Wednesdays, once or twice a month for a total of 12 slots (January to October), excluding July and August   |
| <b>Examinations procedures and schedule</b> | <ul style="list-style-type: none"> <li>- There are 7 profit tests, 1 for modules 1 and 2, 3 for module 3, and 2 for module 4</li> <li>- Assessment will be a test with 4 answers, only one of which is correct, except for the third assessment of module 3, which will be oral.</li> <li>- Examinations will be held in February, March, July, September, October, December and January</li> </ul> |
| <b>Final examination</b>                    | The final examination consists of the presentation of a paper.  |

| <b>Available places and enrolment fees</b> |        |
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| <b>Full-fee students</b>                   |        |
| Minimum number                             | 20     |
| Maximum Number                             | 40     |
| Enrolment fee                              | €2,500 |
| <b>Free-of-charge supernumerary places</b> |        |
| UNIFI employees                            | 1      |
| AOU Careggi Employees                      | 2      |
| <b>Single Modules</b>                      |        |
| None planned                               |        |

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| <b>Description of the activities and training objectives of the internship</b> | <p>The internship is held at Careggi University Hospital on MRI equipment implemented with the latest technology on the market, where second and third-level examinations are performed daily.</p> <p>It aims to see applied in working practice all the technologies, study techniques, technological developments, and advanced applications explained in the various Master's lectures by Medical Physicists for physical principles of MRI imaging, TSRMs for a description of sequences, and in-depth study techniques by district, Radiology Physicians for discussion of technical conduct of examination and Engineers for some specialized lectures.</p> <p>The internship takes place directly at MRI sites equipped with four 1.5T equipment and one 3.0T research equipment, implemented with the latest technology in MRI.</p> <p>The internship also includes a portion of meetings held by Specialists from the Industry who will demonstrate the operation of their latest equipment with the use of simulators. Observational activity.</p> |
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<sup>i</sup> This document is a translation of the form A.1 relating to the characteristics of the course attached to the Decree of the Deputy number 873 (record 158006) of 25th of July 2022, drafted in Italian and issued on the Master | Didattica | Università degli Studi di Firenze | UniFI and which therefore constitutes the only official document. This English translation cannot be used for legal purposes and has the sole purpose of supplying information in English on the content of the public notice.