

### **3) PhD Programme in “INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT)”**

**Places with scholarship:**

- **4** scholarships without specific topic
- **1** with topic **“Continual Knowledge transfer across different deep learning architectural paradigms”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Deep Vision Consulting Srl);

- **1 with topic “More-electric tractors for a more sustainable agriculture”** (with PNRR DM117/2023 – Investment 3.3 for research activities at CNH Industrial Italia SpA);
- **1 with topic “Control algorithms for autonomous off-road navigation of heavy, multi-axle wheeled vehicles in varying- and high-slope environments (flat and rolling)”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Iveco Defense Vehicle SpA);
- **1 with topic “Supervised and self-supervised AI and deep learning for animal analysis”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Farm4Trade Srl);
- **1 with topic “Continual Supervised and self-supervised Learning applied to image and video analysis”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Leonardo SpA);
- **1 with topic “Continual Federated Learning for industry”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Tetra Pak Packaging Solutions SpA);
- **1 with topic “Scalable HPC Data Integration for Very Large Heterogeneous Data Sources”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Leonardo SpA);
- **1 with topic “Use of LoRaWAN and ultrawideband technologies for precise localization applications”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Embit SpA);
- **1 with topic “Methodologies for the Study of State-of-The-Art Microelectronics Materials and Devices”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Applied Materials Italia Srl);
- **1 with topic “Development of innovative sensing technology for biomedical applications”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Fondazione Democenter-Sipe);
- **1 with topic “Innovative electronic measurement systems for the management of electrical energy storage”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Aton Green Storage SpA);
- **1 with topic “Leveraging High-Performance Computing for enhancing Data Quality in AI Training”** (with PNRR DM118/2022 funds, Mission 4, Component 1, Investment 3.4 “Digital and Environmental Transitions” for research activities at Datariver Srl);
- **1 with topic “Development, implementation and testing of techniques based on time series and data mining to environmental, hydrological and hydraulic data”** (with PNRR DM118/2022 funds, Mission 4, Component 1, Investment 3.4 “Digital and Environmental Transitions” for research activities at Po River Basin District Authority);
- **1 with topic “High performance computing and new industries: analysis of application areas and effects on regional supply chains”** (with PNRR DM118/2022 funds, Mission 4, Component 1, Investment 3.4 “Public Administration” for research activities at Regione Emilia Romagna);
- **1 with topic “Wide-bandgap based devices for efficient power conversion”** (financed with EU funds - NextGenerationEU - DD. 3175/2021 AND DD. 3138/2021, within the framework of the PNRR, Mission 4 Component 2 Investment 1.4 "Strengthening of research structures and creation of "national R&D champions" on certain Key Enabling Technologies" - Project: CN\_4: NATIONAL CENTRE FOR SUSTAINABLE MOBILITY - CNMS - Spoke 13 - CUP: E93C22001070001);
- **1 with topic “Computer Vision and Natural Language Processing Technologies for Analysis and Understanding of Cultural and Historical Archives”** (financed with EU funds - NextGenerationEU - DD. 3264/2021, within the framework of the PNRR, Mission 4, "Education and Research" - Component 2, "From research to enterprise" - Investment Line 3.1, "Fund for the realisation of an integrated system of research and innovation

infrastructures" - Project: Italian Strengthening of Esfri RI Resilience (ITSERR): CUP: B53C22001770006);

- **1 with topic “Exploring the Potential of Large Language Models for Multilingual Historical Document Analysis and Semantic Cataloguing in Digital Libraries”** (financed with EU funds - NextGenerationEU - DD. 3264/2021, within the framework of the PNRR, Mission 4, "Education and Research" - Component 2, "From research to enterprise" - Investment Line 3.1, "Fund for the realisation of an integrated system of research and innovation infrastructures" - Project: Italian Strengthening of Esfri RI Resilience (ITSERR): CUP: B53C22001770006);

- **1 with topic “Knowledge Graphs and Distributed Machine Learning Techniques to Manage the Data Lake of multilingual and multi-alphabetic heritages”** (financed with EU funds - NextGenerationEU - DD. 3264/2021, within the framework of the PNRR, Mission 4, "Education and Research" - Component 2, "From research to enterprise" - Investment Line 3.1, "Fund for the realisation of an integrated system of research and innovation infrastructures" - Project: Italian Strengthening of Esfri RI Resilience (ITSERR): CUP: B53C22001770006);

- **1 with topic “Deep Learning techniques and multimodal learning in Biomedical Sciences and Medical Robotics”** (financed by project National Plan for Complementary Investments to the PNRR (PNC) - 'FIT for Medical Robotics' initiative - FIT4MEDROB (PNC00007) - CUP B53C22006810001);

- **1 with topic “Human-AI Robot Interaction in Indoor Environments”** (financed by project National Plan for Complementary Investments to the PNRR (PNC) - 'FIT for Medical Robotics' initiative - FIT4MEDROB (PNC00007) - CUP B53C22006810001);

- **1 with topic “Development of hardware platforms and simulation tools for label free biosensing based on micro- and nano-electronic devices and circuits”** financed by the European Union - NextGenerationEU, PNRR - HUB Foundation "HEAL ITALIA" (CF 97370050821) - Mission 4, Component 2, Investment 1.3 (MUR Directorial Decree of 15 March 2022, no. 341) - Research and Innovation Programme entitled "Health Extended ALLiance for Innovative Therapies, Advanced Lab-research, and Integrated Approaches of Precision Medicine - HEAL ITALIA" – Spoke 6 - identification code PE000019 - CUP E93C22001860006);

- **1 place funded by a three-year research grant with topic “Wide-bandgap based Power converters for improved efficiency and reliability in Automotive”** – Tutor: Prof. Davide Barater – SSD: ING/IND 32 Electrical converters, machines and drives – yearly amount of the grant (gross amount): € 19.367,00 with funds project SCAPE-Switching-Cell-Array-based Power Electronics conversion for future electric vehicles (HORIZON EUROPE - Project number: G.A. no. 101056781, CUP: E93C22000650006)

- **1 place funded by a three-year research grant with topic “Power converter architecture for multi-source, fault-tolerant multiphase machine drives”** – Tutor: Prof. Davide Barater – SSD: ING/IND 32 Electrical converters, machines and drives – yearly amount of the grant (gross amount): € 19.367,00 with funds project SCAPE-Switching-Cell-Array-based Power Electronics conversion for future electric vehicles (HORIZON EUROPE - Project number: G.A. no. 101056781, CUP: E93C22000650006);

- **1 place funded by a three-year research grant with topic “Diagnosis and Control of IPM Motors based on quantum sensors”** – Tutor: Prof. Giovanni Franceschini – SSD: ING/IND 32 Electrical converters, machines and drives – yearly amount of the grant (gross amount): € 19.367,00 with funds project A-IQready - Artificial Intelligence using Quantum measured Information for realtime distributed systems at the edge (HORIZON-KDT-JU) - Project number: G.A. n. 101096658 CUP: CUP: E93C21003990007)

- **1 with topic “Next Generation of Connected Vehicles”** (with PNRR DM117/2023 – Investment 3.3 for research activities at Ferrari SpA);

## Places without scholarship: 5

**Admission requirements:** Italian second level degree (laurea specialistica, under D.M. 509/99 or laurea magistrale, under D.M. 207/04) or Italian degree obtained prior to D.M. 509/99 or equivalent qualification obtained abroad, in accordance with the provisions in art. 2 of this application procedure.

**Selection Procedure (for all the selection procedures): based on academic and research record.** The Course provides for twenty-seven selection procedures depending on the type of places available. Candidates interested in more than one selection procedure must apply and pay the relevant fee of € 25.00 for each procedure in which they wish to participate.

The selections are intended to verify the candidate's preparation and aptitude to carry out research activities related to the topics of the PhD Course.

In addition to the provisions of the art. 3 of this application procedure, candidates have to submit the following documents:

- 1) self-certification of the degree (or degree certificate in the case of a degree obtained abroad) showing the list of examinations taken and grades obtained; in the case of candidates who have not yet taken their final degree examination, the list of examinations taken and grades obtained must be presented;
- 2) curriculum vitae of research and teaching activities, written in Italian or English, indicating university degree qualifications obtained;
- 3) a summary of the master thesis, in Italian or English – minimum of three and maximum of six pages – organised under the following headings: motivations, research methodology used, results obtained, in the case of candidates who have not yet graduated, a written presentation of the thesis that will be discussed;
- 4) a brief statement of no more than two pages written in English, outlining the candidate's motivation for attending the PhD Programme (Motivation) and a description of his/her research interests (Statement of Research Interest). The candidate should express a maximum of two preferences among the research topics available on the Course website <http://www.ict.unimore.it/> - 'Research Topics';
- 5) certification of English language skills (TOEFL, Proficiency or others) if possessed;
- 6) proof of passing the GRE (Graduate Record Examination) test if possessed;
- 7) up to three letters of reference which must be produced directly by the referents and exclusively according to the procedure indicated in art. 3 of this Call.

**1) Main selection procedure (for places with scholarship without specific topic and places without scholarship: based on academic and research record**

**2) Selection procedure for a place with scholarship with topic “Continual Knowledge transfer across different deep learning architectural paradigms”: based on academic and research record**

**3) Selection procedure for a place with scholarship with topic “More-electric tractors for a more sustainable agriculture”: based on academic and research record**

**4) Selection procedure for a place with scholarship with topic “Control algorithms for autonomous off-road navigation of heavy, multi-axle wheeled vehicles in varying- and high-slope environments (flat and rolling)”: based on academic and research record**

- 5) Selection procedure for a place with scholarship with topic “Supervised and self-supervised AI and deep learning for animal analysis”:** based on academic and research record
- 6) Selection procedure for a place with scholarship with topic “Continual Supervised and self-supervised Learning applied to image and video analysis”:** based on academic and research record
- 7) Selection procedure for a place with scholarship with topic “Continual Federated Learning for industry”:** based on academic and research record
- 8) Selection procedure for a place with scholarship with topic “Scalable HPC Data Integration for Very Large Heterogeneous Data Sources”:** based on academic and research record
- 9) Selection procedure for a place with scholarship with topic “Use of LoRaWAN and ultrawideband technologies for precise localization applications”:** based on academic and research record
- 10) Selection procedure for a place with scholarship with topic “Methodologies for the Study of State-of-The-Art Microelectronics Materials and Devices”:** based on academic and research record
- 11) Selection procedure for a place with scholarship with topic “Development of innovative sensing technology for biomedical applications”:** based on academic and research record
- 12) Selection procedure for a place with scholarship with topic “Innovative electronic measurement systems for the management of electrical energy storage”:** based on academic and research record
- 13) Selection procedure for a place with scholarship with topic “Development of design and measurement techniques for EMC-resilient electronic systems”:** based on academic and research record
- 14) Selection procedure for a place with scholarship with topic “Leveraging High-Performance Computing for enhancing Data Quality in AI Training”:** based on academic and research record
- 15) Selection procedure for a place with scholarship with topic “Development, implementation and testing of techniques based on time series and data mining to environmental, hydrological and hydraulic data”:** based on academic and research record
- 16) Selection procedure for a place with scholarship with topic “High performance computing and new industries: analysis of application areas and effects on regional supply chains”:** based on academic and research record
- 17) Selection procedure for a place with scholarship with topic “Wide-bandgap based devices for efficient power conversion”:** based on academic and research record

**18) Selection procedure for a place with scholarship with topic “Computer Vision and Natural Language Processing Technologies for Analysis and Understanding of Cultural and Historical Archives”:** based on academic and research record

**19) Selection procedure for a place with scholarship with topic “Exploring the Potential of Large Language Models for Multilingual Historical Document Analysis and Semantic Cataloguing in Digital Libraries”:** based on academic and research record

**20) Selection procedure for two places with scholarship with topic “Knowledge Graphs and Distributed Machine Learning Techniques to Manage the Data Lake of multilingual and multi-alphabetic heritages”:** based on academic and research record

**21) Selection procedure for a place with scholarship with topic “Deep Learning techniques and multimodal learning in Biomedical Sciences and Medical Robotics”:** based on academic and research record

**22) Selection procedure for a place with scholarship with topic “Human-AI Robot Interaction in Indoor Environments”:** based on academic and research record

**23) Selection procedure for a place with scholarship with topic “Development of hardware platforms and simulation tools for label free biosensing based on micro- and nano-electronic devices and circuits”:** based on academic and research record

**24) Selection procedure for a place funded by a three-year research grant with topic “Wide-bandgap based Power converters for improved efficiency and reliability in Automotive”:** based on academic and research record

**25) Selection procedure for a place funded by a three-year research grant with topic “Power converter architecture for multi-source, fault-tolerant multiphase machine drives”:** based on academic and research record

**26) Selection procedure for a place funded by a three-year research grant with topic “Diagnosis and Control of IPM Motors based on quantum sensors”:** based on academic and research record

**27) Selection procedure for a place with scholarship with topic “Next Generation of Connected Vehicles”:** based on academic and research record

**Methods of evaluation (for all the selective procedures):**

The Selection Committee has the capacity to assign scores up to a total of 60 points in the evaluation of candidate qualifications, as follows:

- Curriculum vitae including research and teaching activities, and description of motivation (Motivation) and research interests (Statement of Research Interest): 0 to 35 points,
- Exams taken and grades achieved: from 0 to 15 points,
- Publications: from 0 to 5 points,
- Other qualifications: from 0 to 5 points.

The Commission has the option of conducting a cognitive interview by videoconference (via Skype), which purpose is to examine in depth the qualifications submitted by candidates. This interview does not involve the awarding of a mark.

The Commission may express an opinion in relation to the aptitude of candidates to follow a curriculum or a research theme.

Once the qualifications have been assessed, the Selection committee will compile a merit-based ranking of candidates based on the scores awarded. Candidates obtaining a minimum score of 40/60 will be considered eligible.

**Areas of the PhD Programme:** The Doctorate offers three curricula: 1) Computer engineering and Science; 2) Electronics and Telecommunications; 3) Industrial Applications of ICT). The topics of the ICT Doctorate concern the disciplines of Computer Engineering and Science, Electronics, Electronic Measurements, Telecommunications, Electromagnetic Fields, Control Theory and Automation and Electrical Engineering, as well as industrial applications of the aforementioned disciplines in the strategic priority areas defined by the Horizon Europe programs, the National Research Program and the National Recovery and Resilience Plan (PNRR).

The Teaching Committee may propose to one or more students enrolled, considered suitable, a programme of study and research in collaboration with the Federal University of Technology – Paraná (Brasil) that will result in the achievement also of the title of Brazilian PhD in "*Doctor in Electrical and computer engineering*", or a study and research path in collaboration with the University of Nottingham (United Kingdom) which will also lead to the achievement of the title of English PhD in "*Engineering PhD*", or a study and research path in collaboration with the Technische Universität Wien (Austria) which will also lead to the achievement of the title of Austrian PhD as "*Doktor der Technischen Wissenschaften*" or "*Doktor der Naturwissenschaften*".

Official course language: English. However, all the PhD students are encouraged to learn the Italian language during the course of study.

Further information is available from the PhD Programme website at: <http://www.ict.unimore.it/> (entry " Research Topics ").

The Course is inside del Doctoral School in "E4E (Engineering for Economics – Economics for Engineering)".