CALL FOR ADMISSION TO PHD PROGRAMME OF 37 CYCLE

A.Y. 2021-2022

ANNEX 1 TO R.D. OF 25 AUGUST 2021, N. 1

<table>
<tr><th colspan="5">PHD PROGRAMME IN
PHYSICAL SCIENCES AND ENGINEERING OF INDUSTRIAL AND ENERGY INNOVATION</th></tr>
<tr><td>ADMINISTRATIVE HEADQUARTERS</td><td colspan="4">Università degli Studi “Guglielmo Marconi”</td></tr>
<tr><td>PROPOSING STRUCTURE</td><td colspan="4">SCHOOL OF APPLIED SCIENCES AND TECHNOLOGIES</td></tr>
<tr><td>SCIENTIFIC AREAS</td><td colspan="2">02 - Physical Sciences;
08 - Civil Engineering and Architecture;
09 - Industrial and Information Engineering;</td><td colspan="2">SS.SS.DD.
FIS/01 - Experimental Physics;
FIS/04 - Nuclear and Subnuclear Physics;
ING-IND/08 - Fluid Machines;
IND-IND/09 - Systems for energy and the environment;
ING-IND/12 - Mechanical and Thermal Measurements;
ING-IND/14 - Mechanical Design and Machine Construction;
ING-IND/15 - Industrial Engineering Design and Methods:
ING-INF/03 - Telecommunications;
ING-INF/05 - Information Processing Systems;
ICAR/07 - Geotechnics;
ICAR/09 - Construction Technique;
ICAR/20 - Technique and Planning; Urban planning</td></tr>
<tr><td>SCIENTIFIC COORDINATOR</td><td colspan="4">Prof. Fabio Orecchini, Full Professor of Energy and Environmental Systems at the Università degli Studi “Guglielmo Marconi”</td></tr>
<tr><td>DURATION OF THE COURSE</td><td colspan="4">3 Years</td></tr>
<tr><td rowspan="3">POSITIONS</td><td>WITH SCHOLARSHIP</td><td>n. 6</td><td colspan="2"></td></tr>
<tr><td>TOTAL</td><td>n. 6</td><td colspan="2"></td></tr>
<tr><td>SUPERNUMERARY</td><td colspan="3">The Academic Board, assessed the actual compatibility with:
✓ the research structures of the University;
✓ the ability of the Academic Board to follow PhD students in carrying out their work and research activities;
✓ possible work performance by PhD students;
<u>may admit as supernumerary, without a scholarship</u>, an adequate number of candidates who are eligible in the ranking, and who fall into the following situations:
a) recipients of research grants pursuant to art. 22 of the law n. 240 of 30 December 2010;</td></tr>
</table>

		b) foreign citizens who do not compete for the assignment of the scholarship; c) employees of Public Administrations, who may benefit from the leave provided for by collective bargaining for the normal duration of the course or, for employees under public law, extraordinary leave for study purposes, compatibly with the needs of the administration, pursuant to art. 2 of the law n. 476 of 13 August 1984, and subsequent amendments, with or without scholarship and unless explicitly waived, only if they are enrolled for the first time in a PhD course, regardless of the disciplinary context; d) recipients of a personal gross annual income of € 16,000.00.
EXAMINATIONS	Admission to the PhD program includes: **a) EVALUATION OF THE CURRICULUM, THE RESEARCH PROJECT AND PUBLICATIONS.** The evaluation will be carried out on the basis of the criteria established in advance by the Commission of selection. **b) WRITTEN EXAMINATION** consisting in the description and elaboration of the research project relating to the areas of the PhD, which can be carried out by the candidate in case of admission to the Course. **c) ORAL EXAMINATION** Oral examination: ✓ will consist in the discussion of the curriculum, the research project and any scientific qualifications; ✓ it will be aimed at verifying knowledge on the subject of PhD; the ability to analyze one's own training curriculum, aptitude for research, interests in scientific study, approach to design thinking; **knowledge of English language.**	
SCORES ATTRIBUTABLE TO THE INDIVIDUAL TESTS	The Commission has a total of 100 points, distributed as follows: ✓ **evaluation of the curriculum and publications: 20/100** ✓ **evaluation of the written exam: 40/100;** ✓ **evaluation of the oral exam: 40/100** • only candidates who achieved a score of not less than 40/60 in the evaluation of the curriculum, of publications and written exam, will be admitted to the oral exam; • the oral exam is considered passed if the candidate has achieved a vote of not less than 25/40; • at the end of the oral exam, the Commission prepares the general merit ranking by adding for each candidate the score reported in the individual tests; • candidates with a minimum overall score of 65/100 will be declared eligible for the Competition.	
	The date and time of the **written examination** will be made known at least 10 days in advance by publishing a notice in the "Calls and Competitions" and "PhD" sections of the University website. By means of this notice, the fulfillment of the disclosure of the documents is deemed to be completed, therefore **such**	

CALENDAR OF EXAMINATIONS	**publication will be valid as notification of the convocation**. Candidates for the admission are therefore required to arrive on the day and at the time indicated without waiting for further personal communications on the matter, with a valid identity document. The date for the **oral exam** may be communicated by the Commission of selection to the candidates on the day of the written exam. There are no notice periods between the written test and the oral test. The absence of the candidate on the scheduled day and time will be considered as a formal renunciation of participation in the Competition.
COURSE ENROLLMENT FEE	Supernumerary candidates declared eligible and admitted to the Course are required, upon enrollment, to pay the **annual contribution of € 5,000.00 (five thousand euro).** The payment of the regional tax is added to this contribution. The recipients of the scholarship are also required to pay the regional tax. The contribution to be paid by foreign citizens, eligible in the general merit ranking, and who do not compete for the scholarship, will be quantified with a specific resolution by the competent Academic Bodies. **The contributions paid will not be returned in any circumstances.**
TRAINING OBJECTIVES	The PhD intends to promote the preparation of professionals capable of being a fulcrum of innovation for industry and society, of contributing to the development of new knowledge, of managing original research and development projects, independently completing programs of strategic importance. To achieve this goal, the Course promotes and supports a strong integration between basic and applied research with a high degree of interdisciplinarity, in the methodological and research fields. This multidisciplinarity is the tool for integrating design, energy and IT engineering skills with those of a physical nature, in order to promote a path capable of training competent people, both in tools and methods for research, and in the ability to transfer these high skills in the field of business innovation. In particular, the doctorate intends to be the tool for the advanced training of professionals able to move within the future technological scenarios in the various application contexts (Industry 4.0, e-Healthcare, Autonomous Driving, etc.) with a multidisciplinary preparation and able to manage technologically advanced industrial production and services from all points of view, where product and process innovation is achieved in an integrated way, for a completely digital production, with management of big data and with a careful look at sustainability and to basic science, the engine of innovation. Furthermore, knowledge of product development methodologies, management and analysis of processes, materials, energy systems of production, storage and use of energy, including advanced mobility systems, will facilitate the implementation of advanced engineering approaches required today by the labor market. A particular aspect, which represents a strategic sector within the PhD, will be the management of innovative biological materials, for the design and implementation of new therapeutic molecules and medical devices for biomedical and clinical use.
RESEARCH AREAS	The PhD programme has training and research contents in strategic topics for high-level innovation such as: • ENERGY SYSTEMS FOR STATIONARY AND MOBILITY USE • SUSTAINABILITY • ENVIRONMENTAL COMFORT • MECHANICAL DESIGN, PRODUCTION PROCESSES AND NEW INDUSTRIAL AND BIOMEDICAL MATERIALS • IT AND TELECOMMUNICATIONS

- MACHINES, MEASUREMENTS AND THERMOFLUID DYNAMICS

Specifically, the main focuses for each of the areas listed above are:

- ENERGY SYSTEMS FOR STATIONARY AND MOBILITY USE
  - Energy systems for the use of renewable sources and their use;
  - Energy systems for energy storage;
  - Efficient use of energy in the industrial, tertiary and residential sectors;
  - Energy and environmental planning;
  - Development of new technologies for the management, production, conversion and transport of energy, with particular reference to environmental protection;
  - Design and optimization of energy production systems for civil and industrial use from renewable sources;
  - Analysis of energy systems: analysis of needs, consumption and demand for energy and balance of polluting emissions;
  - Hydrogen: technologies of production, storage and use;
  - Energy systems for mobility: innovative power trains, HEV (Hybrid Electric Vehicle), BEV (Battery Electric Vehicle), FCEV (Fuel Cell Electric Vehicle);
  - Operating cycles and energy-emission analysis of the use in real conditions (on the road) of vehicles;
  - Research and development of innovative technologies and solutions for motor vehicles and for the industrial, mobility, communication and energy systems in which they are necessarily inserted;
  - Self-driving cars, V2I (Vehicle to Infrastructure) and V2V (Vehicle to Vehicle);
  - Smart Grids;
  - Smart Mobility;
  - Simulation of behavior and performance in transient and steady state and experimental verification on a test bench

- SUSTAINABILITY
  - Environmental impact of energy systems;
  - Models of dispersion of pollutants in the atmosphere;
  - Monitoring of energy / environmental parameters of energy conversion systems;
  - Study and optimization of energy production processes through the preparation of mass and energy balances and life cycle analysis (LCA);
  - R&D studies and actions to establish guidelines that will lead the LCA (assessment of environmental impacts during the life cycle of building services) and LCC (life cycle cost estimates) to become normal standard procedures, with the aim to converge at European level in measurement methods and systems;
  - R&D studies and actions to identify and / or preliminarily define techniques, materials, procedures aimed at the construction, management and disposal of environmentally friendly buildings and / or settlements with high energy efficiency;
  - Life Cycle Assessment (LCA) analysis and evaluation of the economic-employment effects;

- development of Life Cycle Costing (LCC) performance indicators, in order to facilitate performance comparison on a European basis, and use these indicators to assess the sustainability of construction in Europe;
- Smart Cities (and Social Innovation);
- Government of the territory, urban planning and land consumption.

- ENVIRONMENTAL COMFORT
- Calculation algorithms for the energy certification of buildings;
- Study of the thermophysics of buildings, of environmental control techniques and of the thermophysical properties of materials;
- Study of the lighting and acoustic problems of confined and non-confined environments;
- Research and development of new methodologies for the thermohygrometric well-being of confined environments;
- Development of methodologies for the energy certification of buildings and constructions;

- MECHANICAL DESIGN, PRODUCTION PROCESSES AND NEW INDUSTRIAL AND BIOMEDICAL MATERIALS
- Additive manufacturing;
- Eco-design and green design;
- Industrial automation and home automation;
- Biomaterials;
- The safety of machines and workplaces;
- Aided design;
- Industrial automation;
- New technologies;
- Mechatronics;
- Nanotechnologies;
- Reverseengineering and rapidprototyping;
- The development techniques of innovative products and processes;
- The economic aspects of innovation;
- The psycho-social aspects of innovation and design creativity;
- The innovative materials;
- Integrated design techniques (Design for….);
- Process analysis and optimization;
- The development of innovative biological materials, for the design and construction of new therapeutic molecules and medical devices for biomedical and clinical use.

- INFORMATION TECHNOLOGY AND TELECOMMUNICATIONS
- Design, evaluation and management of IT systems and networks;
- Next generation IT architectures;
- Cloud and distributed systems;
- Software engineering;
- Reliability safety and security;
- Databases and knowledge bases;

	° Innovative architectures for the web; ° Natural language processing; ° Machine learning; ° Distributed databases; ° Artificial intelligence; ° Simulation methods and languages; ° Wireless telecommunication systems and new generation networks; ° Satellite systems; ° Applications to experimental and theoretical physics; ° Applications to mathematics; ° Applications to transport systems; ° Applications to classroom and distance learning education systems; ° Applications to advanced traction, land, air and satellite traffic control systems; ° Applications to energy production, conversion and distribution systems; ° Applications to industrial production systems and administrative, economic, banking, health, environmental and social systems; • MACHINES, MEASUREMENTS AND THERMO-FLUID DYNAMICS ° Absorption machines; ° Thermodynamic analysis of advanced energy conversion systems; ° Analysis of subsystems and management strategies of cogeneration plants; ° Heat transmission; ° Applied thermo-fluid dynamics; ° Fluid dynamics of thermal machines; ° Numerical modeling of thermodynamic analysis, heat exchange and fluid dynamics of machines, energy systems and their components; ° Optimization of traditional and innovative energy conversion systems, with particular reference to large-scale integrated systems and for micro-scale plants, with a view to distributed generation; ° Study and development of innovative technologies for combustion, energy conversion and treatment of tributaries and related construction of pilot plants; ° Design and construction of components and demonstration plants on a micro scale for the energy conversion of renewable sources; ° Thermo-chemical-fluid dynamics simulation of machines, plants and their components with commercial calculation codes and creation of dedicated calculation codes and sub-routines to aid the simulation; ° Innovative methods for mechanical and thermal measurements
EDUCATIONAL AND RESEARCH METHODOLOGY	The working methodology will be characterized by a strong interaction between teachers and students and involves the figures belonging to the industry sector and generally to the productive world of industry and services, through seminars, workshops and interventions in the company. The teaching activity includes some specialized courses carried out both with lectures and interactive type of training, with the aid of ICT systems and equipment. The teaching is oriented towards problem solving and includes practical

	exercises and the resolution of case studies. The research activity will be aimed at the study of specific themes, object of the PhD, developed giving priority to the aspects and approaches of a methodological nature, oriented towards the creation of a common ground of comparison between teachers and students in which it is possible to graft and develop innovation and competitiveness. This translates into the establishment of a technological laboratory of ideas and creativity in which the students will address the design and development of innovative and sustainable systems in direct contact with national and international scientific institutions, and companies in the sector of industrial production and services.
EMPLOYMENT OPPORTUNITIES	The aim of the PhD programme is to train experts who, thanks to the skills acquired, are able to guide the development of process and product innovation in the various industrial fields, of efficient and sustainable energy systems, including those for mobility, in order to make companies more competitive on the market. In this sense, future PhD holders, possessing both specialized technical skills and operational skills for managing the development of innovation, will be able to enter either as Innovation Manager, Energy Manager, Fleet Manager or within Research and Development, Design and Production, in both large and medium/small companies. In order to provide a multidisciplinary preparation, and thanks to the combination of applied research and basic science, future PhD students will have the opportunity to learn the most advanced techniques of data processing and process analysis, thus expanding employment opportunities in different sectors. Future PhD holders will therefore be able to find employment at universities, public or private research centers, mechanical, energy, automotive and information industries, companies and bodies responsible for the production and conversion of energy and for the mobility of people and goods, businesses plant engineering, automation and robotics industries, manufacturing companies in general and in the context of services. Particular occupational development may also be given to the transactional and services sector, both for public and private entities, as well as in the applied biotechnology sector in the field of technological innovation in biomedical, clinical and regenerative engineering sciences. Furthermore, if the results obtained during the PhD lead to the development of original and marketable products/processes, it will be possible to participate as protagonists in the creation of new companies and academic spin-offs.
LIST OF NATIONAL AND INTERNATIONAL PARTNERS WITH WHOM INSTITUTIONALIZED RELATIONS ARE ESTABLISHED	**NATIONAL REFERENCES** • FERRARI SpA – Maranello • CENTRO RICERCHE FIAT – Orbassano • GE OIL & GAS – NUOVO PIGNONE – Florence • BONFIGLIOLI RIDUTTORI S.p.A. Bologna • PIAGGIO & C. SpA – Pontedera • ASSOKNOWLEDGE – Rome • TOYOTA MOTOR ITALIA S.p.A – Rome **INTERNATIONAL REFERENCES** • Imperial College London - UK

	• Ohio State University Columbus - USA • Fermilab – USA • Cern – SWITZERLAND • Mit - Massachusetts Institute Of Technology - USA
RESPONSIBLE OFFICE	PHD OFFICE UNIVERSITA' DEGLI STUDI "GUGLIELMO MARCONI" Via Plinio, 44 00193 – ROME Tel. 06/37725648 PEC: dottoratidiricerca@pecunimarconi.it e-mail: dottoratidiricerca@unimarconi.it web. www.unimarconi.it
DEADLINE FOR SUBMISSION OF APPLICATIONS	**Applications must be received, under penalty of forfeiture, within the peremptory term of 30 days starting from the day following the publication of the relevant notice in the Gazzetta Ufficiale - IV Special Series -, according to the procedure indicated in Article 4 of the call.**