**ANNEX 1/b**

**PhD program: ENGINEERING FOR INNOVATION AND SUSTAINABLE DEVELOPMENT**

**XXXVIII CICLO – a.a. 2022-2023**

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| **Department** | **Engineering School (SI-UniBas) - Potenza** | |
| **Coordinator** | Prof.ssa Aurelia SOLE<br>e-mail: aurelia.sole@unibas.it | |
| **Duration** | 3 years | |
| **Web site** | http://ingegneria.unibas.it/site/home/offerta-formativa/dottorati-di-ricerca/articolo64.html | |
| **Admission requirements** | a) University degree obtained under the previous educational systems (ex ante D.M. 509/99, whose legal course has at least a four-year term);<br>b) Laurea specialistica/magistrale (D.M. 509/99 and Dm 270/2004);<br>c) Academic title obtained abroad and eligible for access to the PhD program, previously recognized by academic authorities, even in the context of inter-university cooperation and mobility agreements. In the absence of such approval, the candidate must apply a request in the application form according to the Art. 3 of this call. | |
| **Available positions** | **Tech4You** | **5 scholarships** |
| | **Other** | **1 scholarship Regione Basilicata - FSC**<br>**1 scholarship CNR-IMAA**<br>**2 scholarships INPS** |

**SCHOLARSHIPS**

**Ecosistema dell'Innovazione "Tech4You - Technologies for climate change adaptation and quality of life improvement" - ambito di intervento "5.Climate, Energy and Sustainable Mobility"**

**Codice identificativo ECS00000009 – CUP C43C22000400006**

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| **Scholarship n. 1** | **Spoke 2 – Tecnologie per ridurre il consumo energetico e salvare la biodiversità**<br>**GOAL 2.1 - PP 2.1.1** |

**Research topic**

Use of treated urban wastewater for applications in bio-energy chains

**Topic description**

The possibility of producing ligno-cellulosic biomass on a large scale at low cost and zero emission impact lies in the availability of water for the irrigation of bio-energy crops. To this end, it is unthinkable to use the water destined for the conventional, civil, industrial and agricultural sectors), while the reuse of the large quantities of waste water currently discharged into the sea or into the terminal stretches of watercourses is particularly interesting.
For these resources, if intended for the irrigation of non-food crops, there is also the possibility of carrying out simplified purification treatments for the recovery of nitrogen and phosphorus fertilising materials.
The sector can have quantitatively significant developments and widespread diffusion on the territories in plants from a few tens to a few thousand hectares of interested hectares. By way of example, consider that a quantity of water corresponding to the discharge of 10,000 inhabitants allows the irrigation of about 200 hectares and the production of over 400 tons/year of dry mass.
The research activity proposed for this PhD scholarship involves the construction of a pilot unit for wastewater treatment and irrigation. The activities will be carried out in collaboration with the Acquedotto Lucano S.p.A. which will host the PhD student for the stage period.

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| **Scholarship n. 2** | **Spoke 2 – Tecnologie per ridurre il consumo energetico e salvare la biodiversità**<br>**GOAL 2.5 - PP 2.5.2** |

**Research topic**

Impact of Renewable Energy Sources plants on Ecosystem Services

**Topic description**

Ongoing climate changes and increasing people's awareness call for an even more urgent reflection on territorial resilience, decarbonization processes and ecological transition, and efficient use of natural resources.
If on one side, there is a growing awareness of environmental aspects, on the other side, the financing plan implemented by the Italian government (National Recovery and Resilience Plan), based on significant interventions, could create several conflicts. This trend has been accelerated by the significant increase in energy demand due to the Ukrainian war. All these aspects produce a complex process of territorial transformation of clean energy production, unfortunately, not supported by an accurate monitoring system that identifies significant impacts on other territorial values.
Starting from a temporal evolution of Renewable Energy Sources plants, the research activity includes the construction of a multidimensional performance-based planning system where alternative low-carbon transition scenarios could be compared to consider territorial specializations and identity assets as a tool to drive decision-making in a sustainable planning perspective.
The evaluation of the scenarios for the development of renewable energy sources through indicators of multifunctionality of ecosystem services on a territorial scale allows to measure the territorial impact concerning the following fundamental categories:
• life support (such as nutrient cycling, soil formation, and primary production),
• supply (such as the production of food, drinking water, materials, or fuel),
• regulation (such as climate regulation, water purification, pollination, and pest control),
• cultural values (including aesthetic, educational, and recreational ones).
The research activity is developed in a multidisciplinary framework and includes interaction with the research group involved in the implementation of the Teach4You Spoke 2 Goal 2.5 PP2 pilot project.

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| **Scholarship n. 3** | **Spoke 4 – Resilienza e accessibilità per la valorizzazione del patrimonio locale (culturale e naturale**)<br>**GOAL 4.2 - PP 4.2.2** |

**Research topic**

Advanced tools and techniques for the territorial assessment of tourism ecosystems: data driven approaches and multiscalar applications of Machine Learning and Artificial Intelligence

**Topic description**

The research activity includes the construction of data-driven territorial models for the assessment of the demand and supply of tourist services. These complex information structures represent a decision support systems (DSS) for the design, management and monitoring of territorial development programs based on the tourist enhancement of the territorial heritage.
The main components of the research refer to:
- evaluation and selection of analytical methodologies based on AI and ML for the spatial analysis of complex phenomena;
- implementation of a spatial data infrastructure including selected data sources relevant to the research objectives and case studies;
- definition of methodologies for the interpretation of analytical models addressing the mainstream programs for territorial development;
- dissemination of research results.
The research products will be applied within local actions in sample contexts aimed at the co-design (participatory planning) of development scenarios for territorial tourist ecosystems.
The research activity is developed in a multidisciplinary framework and includes interaction with the research group involved in the implementation of the Teach4You Spoke 4 Goal 4.2 PP2 pilot project.

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| **Scholarship n. 4** | **Spoke 4 – Resilienza e accessibilità per la valorizzazione del patrimonio locale (culturale e naturale**)<br>**GOAL 4.2 - PP 4.2.2** |

**Research topic**

Tourism ecosystems and innovations in territorial development models for inland areas: from the evaluation of niches of territorial value to the co-design of sustainable local development

**Topic description**

The research activity includes the definition of an evaluation system of territorial development processes and strategies based on the tourist enhancement of territorial heritage. This is based on a systemic territorial knowledge that integrates the quantitative dimension of spatial phenomena evaluation with the perception of anthropic-cultural factors determining the tourist potential of the places. The focus concerns marginal territories (inland areas) where the models of mass tourism, specialized tourism, major attractions as infrastructure investment generating the preconditions for tourism, do not allow the construction of sustainable scenarios in the medium-long term. The territorial structures in the study contexts will be evaluated according to a polycentric approach aimed at verifying the relationships among attractors (specific values of the cultural and environmental heritage), tourist facilities (services and equipment), tourist flows.
The main components of the research refer to:
- literature state of the art on tourism development models and best practices in marginal territorial contexts
- evaluation and selection of analytical methodologies for the quantitative analysis of the territorial processes in selected sample areas
- construction of a spatial data infrastructure relevant to the research objectives and the sample contexts
- application of participatory planning methods and procedures for the development of territorial tourist ecosystems
- definition of adequate "Place Branding" processes with the key actors in the case studies tourism ecosystems - dissemination of research results.
The research activity is developed in a multidisciplinary framework and includes interaction with the research group involved in the implementation of the Teach4You Spoke 4 Goal 4.2 PP2 pilot project.

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| **Scholarship n. 5** | **Spoke 2 – Tecnologie per ridurre il consumo energetico e salvare la biodiversità**<br>**GOAL 2.1 - PP 2.1.1** |

**Research topic**

Energy managment control in microgrid powered by renewable sources and hybrid battery/hydrogen storage

**Topic description**

The research activity aims at the investigation of the performance of a microgrid serving a small community of consumers, with energy production from renewable sources and hybrid energy storage in battery pack or in the form of compressed hydrogen. The renewable source must be preferentially photovoltaic or a combination of photovoltaic and wind. Objective of the investigation is to achieve the highest possible degree of autonomy for the community of consumers addressed by the study, including the disconnection from the main grid (offgrid mode).
The research activity can include:
• modeling of the main components of the microgrid (energy production system, electrical load, battery, electrolyzer, fuel cell, voltage and current converters);
• Cost analysts and optimization of the microgrid component sizes;
• Development of energy management strategies for the microgrid, in particular through the use of forecasting models able to predict in advance electrical load and energy production profiles;
• Development of strategies for the profitable interaction of neighboring hybrid microgrids.

**OTHER SCHOLARSHIPS**

| **Scholarship n. 1** | **Regione Basilicata -FSC** |
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**Research topic n. 1**

Structural health monitoring of existing structures and infrastructures

**Topic description**

High vulnerability of existing structural, infrastructural and monumental heritage, together with the necessity of a better control of safety related to strategic structures and infrastructures located in sensitive areas, is driving researchers to perform in-depth studies to develop advanced techniques for structural monitoring at different scales, from the territorial one up to a single building or infrastructure. In recent years, structural monitoring has received increasing interest from both scientific and professional communities. The main reason of this interest lies on the one hand, from the limitations associated to the use of traditional methods based on visual inspections and, on the other hand, in the great potential offered by an automatic system able to detect in real time o quasi-real time the state of the health of structures in terms of reliability and useful to reduce costs of maintenance. An ever-growing number of structures and infrastructures, all over the world, are subject to the signs of time with deterioration of the mechanical characteristics due to aging and/or inadequate maintenance. Structural Health Monitoring, continuous or discrete, can be very useful to quickly identify criticalities occurred and to provide useful support for a rational planning of maintenance interventions (reliable and economically sustainable), guaranteeing updated information about the state of health of structures and infrastructures. That is also important for the management of critical events due to natural or anthropic sources. In fact, continuous monitoring can provide multi-level information on structures just before and after a critical event driving the first recovery interventions.

**Research topic n. 2**

Design of green interventions to reduce landslide hazard in the view of climate change

**Topic description**

The research project is focused on landslide risk mitigation in urbanized slopes affected by landslides, by means of innovative monitoring and stabilization systems that guarantee both the conservation of ecosystems with their biodiversity and the reduction of climate change impact.
The case studies are represented by landslides in the Basento river valley - both in the Apennine chain area and in the Bradanic Trough (Basilicata region, Italy) - which affect the towns arising on the mountains and on the hills and their main infrastructures. Two different types of clay landslides will be considered that respond differently to the climatic changes expected for the area. For each of the two types, efficient monitoring systems and interventions will be studied - from the alimentation zone to the accumulation in the river valley - to reduce the hazard. New systems for monitoring the deformations of landslides and structures based on the use of optical fibres will also be tested. The possible triggering factors of the movements will be analysed in depth, among them: 1) hydraulic permeability distribution in the subsoil and its influence on pore water pressure distribution along the shear zone, 2) mechanical deterioration caused by changes in the pore fluid composition. In the considered landslides the experimentation on the intervention will consider: a) eco-compatible improvement of the mechanical characteristics of the soils by modifying the composition of the pore fluid, b) planting of proper vegetation, c) design of innovative deep drainage systems reaching the critical zones of the subsoil where shear strains and displacements occur. Economic and environmental sustainability, green transition and technological innovation are the basic inspiring criteria.
The project includes laboratory and field experimentation as well as numerical simulation of the observed phenomena for the prediction of the effects of climate change and of the proposed risk reduction systems.

| **Scholarship n. 2** | **CNR-IMAA** |
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**Research topic**

Data Science and Applied Geophysics for seismic risk mitigation in urban areas

**Topic description**

Italy is characterised by the presence of a large number of medium-large cities and historic centers where most of the population lives with a high seismic risk. For the mitigation of this risk, it is necessary to plan innovative actions aimed at making the territory and the built environment safe. Science is making a fundamental contribution in this direction because the knowledge and technological development has reached such a point that it is possible to integrate a wide spectrum of geophysical methodologies for the seismic characterization of the urban subsoil, for the structural characterization of the built environment and its interaction with the urban soils during seismic events. Knowing the seismic response in every part of the cities and how the urban subsoil interacts with overlying buildings during seismic events is of fundamental importance for correct planning and for the safety of our built heritage and for seismic risk mitigation purposes. Furthermore, the development of non-invasive and low-cost seismic sensors, electromagnetic sensors and advanced data analysis methods (seismic interferometry, machine learning, etc...) make it possible to acquire and analyze a large amount of data in real time for real-time control of the state of health of critical structures (hospitals, schools, prefectures, etc.) and infrastructures (bridges, tunnels, dams, energy pipelines, etc.).

| **Scholarship n. 3** | **INPS** |
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**Research topic**

Earth Observation Big-Data for sustainable flood risk management

**Topic description**

The flood risk is rapidly increasing due to several factors: hazard (due to climate change), exposure and vulnerability (due to land consumption and uncontrolled urbanisation) and to their interactions. On the other hand, the growing availability of numerical tools and data allows a quantification of the risk both for the prevention and for the mitigation with a view to sustainable and smart development of our territories.
The proliferation of satellite systems generates large volumes of increasingly complex data, which can be defined as big data. Such resources will be used to develop low complex techniques, with machine learning algorithms, useful in areas where, the application of traditional numerical models, is difficult. Remote sensing big data will be used to obtain direct information on flooding and to better represent the extention of the flooded area and the temporal dynamics of the event. This approach is particularly useful in areas where data is insufficient to enforce of numerical models. Potential applications include prevention, emergency management in time real and post-event (damage assessment; reconstruction activity).

| **Scholarship n. 4** | **INPS** |
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**Research topic**

COllaboRative Smartlogistics 4 SUstainable REmanufacturing [CORS4SURE]

**Topic description**

The proposal acts in the field of ReManufacturing. The project aims at identifying operative and logistics (using a cloud based approach) modules to sustain technical and economic and social sustainability. The main objective is: to define agents and rules acting in a ReManufacturing scenario; to select tools and variables for monitoring and controlling in ReManufacturing; to evaluate product adaptability to ReManufacturing solutions. The project aims at considering reuse and disposal for electrical and electronic components with application in the automotive sector. The proposal has to integrate ReManufacturing strategies in the perspective of information sharing with cloud approach

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| **A period in the company or research center (max 6 months) and abroad (max 6 months) is mandatory.** | | |
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| **Admission procedure** | The admission procedure is conducted through the:<br>**a) evaluation of qualifications**<br>**b) evaluation, as part of the interview, of a research project**, drawn up in Italian and English using the format set out in **Annex C** to the call for proposals, concerning the subject/type of grant for which you are competing (Tech4You, other)<br>**c) video conference interview** using google meet | |
| **Evaluation criteria** | **a) evaluation of qualifications:** up to a maximum of **25 points**<br>minimum score to access the interview **15 points**<br>**b) interview:** up to a maximum of **75 points**<br>the interview is passed for a score not less than **45 points**<br>**Minimum total score: 60 out of 100.** | |
| **Assessable qualifications** | **Graduation Thesis**<br>(The candidate must also submit a summary in Italian or English of the thesis of max 16.000 characters) | max **12** points |
| | **Degree mark**<br>(For candidates who have not yet obtained the degree, the weighted average of the marks obtained in all the exams of the degree program, taken on the date of submission of the application for admission, will be evaluated) | max **8** points |
| | **Scientific publications**<br>(Articles in national and international scientific journals, proceedings of scientific conferences, books or book chapters) | max **3** points |
| | **Other titles**<br>(University degrees or Master Specialization, Research Grants, Scholarships, Erasmus scholarships and periods of activity abroad, …) | max **2** points |
| **Interview program** | The interview, which can be held in Italian or English, will focus on the discussion of the submitted research project and is aimed at ascertaining the candidate's scientific interests and aptitude for research.<br>During the interview, the knowledge of the Italian language will be ascertained for foreign candidates. | |
| **Foreign language** | **English** (knowledge of a foreign language will be assessed during the interview) | |

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| **Schedule of the admission tests** | **Evaluation of qualifications: results will be available from <u>January 26, 2023</u>** on the website http://portale.unibas.it/site/home/didattica/dottorati-di-ricerca.html<br><br>**Day of the interview: <u>January 30-31, 2023 - 10:30 a.m.</u>** |