

**CALL FOR APPLICATIONS FOR
XXXVIII DOCTORATE CYCLE GRANTS
AS PART OF THE NATIONAL RECOVERY AND RESILIENCE PLAN (PNRR),
THE AGREEMENT BETWEEN POLITECNICO DI BARI AND INPS AND THE
SURFACE PROJECT (ERC-STARTING GRANT)
A.A. 2022/2023**

Rectoral Decree. no. 223/2023

THE RECTOR

- IN VIEW OF Law 476 (13 Aug 1984) on regulations governing scholarships and doctorate research programmes at Italian universities;
- GIVEN Law 105 (5 Feb 1992), specifically art.20 and subsequent modifications and additions;
- GIVEN Law 675 (31 December 1996) and subsequent modifications and additions;
- GIVEN Law 210 (3 Jul 1998), as modified by Law 240 (30 Dec 2010);
- GIVEN Ministerial Decree 224 (30 Apr 1999);
- GIVEN Ministerial Decree 509 (3 Nov 1999) on didactic autonomy of universities;
- GIVEN Presidential Decree 445 (28 Dec 2000), Consolidated Law on legislative measures and regulations for administrative records;
- GIVEN Legislative Decree 82 (7 Mar 2005) and subsequent modifications and additions;
- GIVEN Prime Ministerial Decree of 9 Apr 2001 on measures for equal treatment for rights to university studies;
- GIVEN Legislative Decree 68 (29 Mar 2012), specifically art.18.8;
- GIVEN Apulian Regional Law 45 (28 Dec 2012), specifically art.11;
- GIVEN Ministerial Decree 270 (22 Oct 2004);
- GIVEN Ministerial Decree 198 (23 Oct 2003), arts. 3 and 6, Ministerial Decree 263 (9 Aug 2004) and Ministerial Decree 492 (3 Nov 2005);
- GIVEN current Ministerial and Rector's measures for the containment and management of the Covid-19 emergency;
- GIVEN the "Protocol for Public Examination Procedures" published as part of the Ministry of Health decree of 25 May 2022;
- GIVEN the Politecnico di Bari Statute issued by Rectoral Decree no.175/2019;
- GIVEN the Politecnico di Bari Ethical and Behavioural Code, issued as part of Rector's Decree 582 (28 Sept 2018);
- GIVEN Ministerial Decree 226 (14 Dec 2021), "Regulations concerning accreditation procedures for institutes and doctorate programmes and criteria for establishment of doctorate programmes on the part of accredited institutes";
- GIVEN the Politecnico di Bari Doctorate Research Programme Regulations, issued as part of Rectoral Decree 288 (11 Mar 2022);

- GIVEN Ministerial Decree 247 (23 Feb 2022), modifying the Ministerial Decree 40 (25 Jan 2019) regarding annual amount of PhD programme grants, which from 01/07/2022 increase from €15,343.28 to €16,243.00 (gross total before social security contributions made by the beneficiary);
- GIVEN the 2022-23 Fees and Contributions Regulations;
- GIVEN the National Recovery and Resilience Plan – PNRR;
- GIVEN the public notice for the presentation of project proposals to enhance research structures and create “National Champions” in R&D for Key Enabling Technologies, to be funded as part of the NRRP, Mission 4 Component 2 Investment 1.4, European Union NextGenerationEU (Ministry of Universities and Research Ministerial Decree no. 3138 (16 Dec 2021));
- GIVEN the participation of Politecnico di Bari in two National Centre programmes entitled “National Centre for Sustainable Mobility - CN MOST” as part of the Sustainable Mobility topic area CUP D93C22000410001 and “National Centre for HPC, Big Data and Quantum Computing Research – CN HPC” as part of the High Performance Simulations, Calculations and Analysis topic area CUP D93C22000430001;
- GIVEN Ministry of Universities and Research Decree no. 548 (32 Mar 2022), “public notice for the presentation of project proposals to enhance research structures and create “National Champions” in R&D – NRRP – MUR – “phase 1, approval of project proposal shortlist”;
- GIVEN MUR Director’s Decree no. 1033 (17 Jun 2022) granting funding for a National Centre for Sustainable Mobility – CN MOST;
- GIVEN MUR Director’s Decree no. 1031 (17 Jun 2022) granting funding for a National Centre for HPC, Big Data and Quantum Computing Research – CN HPC;
- GIVEN the public notice for the presentation of project proposals to create “Extended Partnerships for Universities, Research Centres and Companies to Fund Basic Research Projects” as part of NRRP, Mission 4 “Education and Research” – Component 2 “From Research to Business” – Investment 1.3, to be funded by the European Union NextGenerationEU programme (MUR Ministerial Decree no. 341 (15 Mar 2022));
- GIVEN the participation of Politecnico di Bari in three Extended Partnerships entitled “RESTART - REsearch and Innovation on Future Telecommunications Systems and Networks, to make Italy more smART” as part of topic area “Telecommunications of the Future” – CUP D93C22000910001, “3A-ITALY” as part of topic area “Made-in-Italy Circular and Sustainable” – CUP D93C22000920001 and “NEST - Network 4 Energy Sustainable Transition” as part of topic area 2 “Future Energy Scenarios - Subtopic 2.a. Future Green Energy” – CUP D93C22000900001;
- GIVEN Director’s Decree no. 1243 (2 Aug 2022) “Public notice for the presentation of project proposals to create Extended Partnerships for universities, research centres and companies to fund basic research projects” – “phase 1, approval of project proposal shortlist”;
- GIVEN MUR Director’s Decree no. 1549 (11 Oct 2022) granting funding for Extended Partnerships entitled “RESTART - REsearch and innovation on future telecommunications systems and networks, to make Italy more smART”;
- VISTO MUR Director’s Decree no. 1561 (11 Oct 2022) granting funding for Extended Partnerships entitled “NEST - Network 4 Energy Sustainable Transition”;
- VISTO MUR Director’s Decree no. 1551(11 Oct 2022) granting funding for Extended Partnerships entitled “3A-ITALY”;

- GIVEN the “Reporting Guidelines for Implementors of Initiatives under Mission 4 Component 2”;
- GIVEN the Research Project “SURFACE” within the European Research Council (ERC-2021-STG. Proposal ID: 101039198) – CUP D95F22000430006, P.I. Prof. Antonio Papangelo;
- GIVEN Rectoral Decree no. 1392 (21 Dec 2022) approving the agreement between Politecnico di Bari and INPS, regarding PhD grants in favour of children and orphans of members registered to *Gestione unitaria delle prestazioni creditizie e sociali* and retirees users of *Gestione dipendenti pubblici*, academic year 2022-2023, XXXVIII cycle – CUP D93C23000050005;

HAVING ASCERTAINED the availability of financial resources;

HEREBY DECREES

Art. 1: INITIATIVE OBJECTIVES AND AVAILABILITY

Politecnico di Bari is holding a public selection process to **allocate 28 Doctorate Research grants, of which 23 as part of the National Recovery and Resilience Plan (NRRP), Mission 4 component 2 "From Research to Business",** financed by the European Union’s NextGenerationEU, **4 as part of the agreement between Politecnico di Bari and INPS, and 1 related to SURFACE research project of the European Research Council (ERC),** for XXXVIII cycle Doctorate Research courses, academic year 2022/23 at the Politecnico di Bari’s Doctorate School (SCU.DO.).

It is hereby specified that the abovementioned selection procedure is **exclusively for the allocation of doctorate research positions with grant funding.**

The 28 places available are distributed as follows:

- 3 as part of “National Centres” (CN) - PNRR,
- 20 as part of “Extended Partnerships” (PE) - PNRR;
- 4 as part of INPS agreement;
- 1 as part of SURFACE Research Project (European Research Council)

Grants will be allocated to Politecnico di Bari Doctorate Research courses as follows:

DOCTORATE RESEARCH COURSE	PNRR INVESTMENT		INPS	SURFACE ERC
	CN	PE		
Ph.D. IN MECHANICAL AND MANAGEMENT ENGINEERING <i>(hereafter abbreviated to DRIMEG)</i>	1	2	/	1
Ph.D. IN ELECTRICAL AND INFORMATION TECHNOLOGY ENGINEERING <i>(hereafter abbreviated to DRIEI)</i>	/	17	/	/
Ph.D. IN RISK, ENVIRONMENTAL, TERRITORIAL AND BUILDING DEVELOPMENT <i>(hereafter abbreviated to DRSATE)</i>	/	1	1	/
INTER-UNIVERSITY Ph.D. (WITH UNIVERSITY OF BARI “ALDO MORO”) IN AEROSPACE SCIENCES AND ENGINEERING <i>(hereafter abbreviated to DRISA)</i>	2	/	/	/
INTER-UNIVERSITY Ph.D. (WITH UNIVERSITY OF BARI “ALDO MORO”) IN INDUSTRY 4.0 <i>(hereafter abbreviated to DRI4.0)</i>	/	/	3	/

PhD programmes have a 3-year duration, with a starting date of 1 Apr 2023. All teaching is carried out in English.

The current call is deemed official notification to all intents and purposes. All correspondence with candidates for this public notice will be by e-mail. To this end, the e-mail address used by candidates on their application form will be used.

Art. 2: GRANT DETAILS

The following grants will be available for the Doctorate Research courses set out below;

1. Ph.D. IN MECHANICAL AND MANAGEMENT ENGINEERING – DRIMEG

Coordinator: Prof. Giuseppe Casalino

Department of Mechanics, Mathematics and Management

Extended Partnership (PE) "Made in Italy: Circular and Sustainable"(3A-ITALY)				
SPOKE	SCIENTIFIC SUPERVISOR	GRANT COORDINATOR	GRANTS AVAILABLE	TOPIC AREA
Spoke 5 "Factories and Processes for Sustainability and Circularity"	Prof. Salvatore Digiesi	Prof. Salvatore Digiesi	1	Evaluation of circular performances and rebound effects in I4.0-driven circular manufacturing.

Extended Partnership (PE) "Network 4 Energy Sustainable Transition" (NEST)				
SPOKE	SCIENTIFIC SUPERVISOR	GRANT COORDINATOR	GRANTS AVAILABLE	TOPIC AREA
Spoke 4 "Clean Hydrogen and Final Uses"	Prof. Marco Torresi	Prof. Marco Torresi	1	Systems and Technologies for final uses: development of accurate numerical simulations of the combustion of hydrogen, ammonia and blends of hydrogen with new fuels, towards the decarbonization of the energy production. (<i>see topic description in Attachment 1</i>)

National Centre (CN) "National Centre for Sustainable Development" (MOST)				
SPOKE	SCIENTIFIC SUPERVISOR	GRANT COORDINATOR	GRANTS AVAILABLE	TOPIC AREA
Spoke 11 "Innovative Materials and Reduction"	Prof. Gianfranco Palumbo	Prof. Giuseppe Casalino	1	Enhance the Additive Manufacturing Knowledge and Usability for Multimaterial Applications (<i>see topic description in Attachment 2</i>)

SURFACE (European Research Council – ERC 2021)		
SCIENTIFIC SUPERVISOR	GRANTS AVAILABLE	TOPIC AREA
Prof. Antonio Papangelo	1	Mechanical design of micro-structured polymeric adhesive surfaces through techniques based on big-data analysis (<i>see topic description in Attachment 3</i>)

2. Ph.D. IN ELECTRICAL AND INFORMATION TECHNOLOGY ENGINEERING – DRIEI

Coordinator: Prof. Mario Carpentieri

Department of Electrical Engineering and Information Technology

Extended Partnership (PE) <i>“Network 4 Energy Sustainable Transition” (NEST)</i>				
SPOKE	SCIENTIFIC SUPERVISOR	GRANT COORDINATOR	GRANTS AVAILABLE	TOPIC AREA
Spoke 2 “Energy Harvesting and Offshore Renewables”	Prof. Sergio Camporeale	Prof. Mario Carpentieri	1	The PhD student will be involved in the PNRR project entitled “Network 4 Energy Sustainable Transition (NEST)”. The research activities to be carried out will focus on the "Development of new devices for energy harvesting" (WP 2.3)
Spoke 7 “Smart Sector Integration”	Prof. Elio De Tuglie	Prof. Elio De Tuglie	1	Technologies and solutions for monitoring, optimization and control of integrated energy system - The PhD student will be involved in the program of the project "NEST, Network for Energy Sustainable Technologies". The research activity to be carried out will focus on "Development and testing of solutions and technologies for smart sector integration".

Extended Partnership (PE) <i>“RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart” (RESTART)</i>				
SPOKE	SCIENTIFIC SUPERVISOR	GRANT COORDINATOR	GRANTS AVAILABLE	TOPIC AREA
Spoke 1 CNR “Pervasive and Photonic Network Technologies and Infrastructures”	Prof. Alfredo Grieco	Prof. Vincenzo Petruzzelli, Prof. Vittorio Passaro	2	The PhD student will be involved in the PNRR project entitled “RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART)”. The research activities to be carried out will focus on “Pervasive and Photonic Network Technologies and Infrastructures”
Spoke 2 PBA “Integration of Networks and Services”	Prof. Alfredo Grieco	Prof. Alfredo Grieco, Prof. Gennaro Boggia, Prof.ssa Antonella D’Orazio, Prof.ssa Caterina Ciminelli	5	The PhD student will be involved in the PNRR project entitled “RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART)”. The research activity to be carried out will focus on "Integration of Networks and Services"
Spoke 2 PBA “Integration of Networks and Services”	Prof. Alfredo Grieco	Prof. Gennaro Boggia, Prof.ssa Antonella D’Orazio	2	The PhD student will be involved in the PNRR project entitled “RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART)”. The research activity to be carried out will focus on "Integration of Networks and Services"

Spoke 3 PMI "Wireless Networks and Technologies"	Prof. Alfredo Grieco	Prof. Francesco Prudeniano, Prof. Luciano Mescia	2	The PhD student will be involved in the PNRR project entitled "RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART)". The research activity to be carried out will focus on "Wireless Networks and Technologies"
Spoke 3 PTO "Programmable Networks for Future Services and Media"	Prof. Alfredo Grieco	Prof. Saverio Mascolo	2	The PhD student will be involved in the PNRR project entitled "RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART)". The research activity to be carried out will focus on "Programmable Networks for Future Services and Media"
Spoke 6 UCT "Innovative Architectures and Extreme Environments"	Prof. Alfredo Grieco	Prof. G. Gennaro Boggia, Prof. Giuseppe Piro	2	The PhD student will be involved in the PNRR project entitled "RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART)". The research activity to be carried out will focus on "Innovative Architectures and Extreme Environments".

3. Ph.D. IN RISK, ENVIRONMENTAL, TERRITORIAL AND BUILDING DEVELOPMENT – DRSATE

Coordinator: Prof. Vito Iacobellis

Department of Civil, Environmental, Land, Building Engineering and Chemistry

Extended Partnership (PE) <i>"Network 4 Energy Sustainable Transition" (NEST)</i>				
SPOKE	SCIENTIFIC SUPERVISOR	GRANT COORDINATOR	GRANTS AVAILABLE	TOPIC AREA
Spoke 2 "Energy Harvesting and Offshore Renewables"	Prof. Sergio Camporeale	Prof.ssa Concetta Immacolata Giasi, Prof. Nicola Pastore	1	Integration of control - oriented modeling and operational optimization for the improvement the use of the shallow geothermal energy (<i>see topic description in Attachment 4</i>)

INPS		
SCIENTIFIC SUPERVISOR	GRANTS AVAILABLE	TOPIC AREA
Prof. Fabio Fatiguso	1	Multimodal approach to the mitigation of environmental, territorial and building risk in line with objectives n. 9, 11 and 13 of the United Nations 2030 Agenda for the sustainable development

4. INTER-UNIVERSITY PH.D. (WITH UNIVERSITY OF BARI "ALDO MORO") IN AEROSPACE SCIENCES AND ENGINEERING – DRISA

Coordinator: Prof. Marco Donato De Tullio

Department of Mechanics, Mathematics and Management

National Centre (CN)				
"National Centre for Big Data and Quantum Computing" (HPC)				
SPOKE	SCIENTIFIC SUPERVISOR	GRANT COORDINATOR	GRANTS AVAILABLE	TOPIC AREA
Spoke 2 "Fundamental Research & Space Economy"	Prof. Nicola Giglietto	Prof.ssa Elisabetta Bissaldi	1	Studi di algoritmi di ricostruzione di raggi gamma in banda MeV da satellite, rivelati attraverso effetto Compton per il Centro Nazionale di Ricerca in HPC, "Big data" e "Quantum Computing". Le attività di ricerca riguarderanno lo sviluppo di algoritmi specifici, nel contesto della fisica delle alte energie applicata al campo aerospaziale, per l'analisi dell'interazione attraverso effetto Compton dei fotoni in banda gamma al MeV all'interno di rivelatori traccianti su satellite di piccole e medie dimensioni, mediante opportune tecniche di simulazione e sviluppo algoritmi per il Centro Nazionale di Ricerca in HPC, "Big data" e "Quantum Computing", nell'ambito del Piano Nazionale di Ripresa e Resilienza"
Spoke 2 "Fundamental Research & Space Economy"	Prof. Nicola Giglietto	Prof. Nicola De Fillippis	1	Sviluppo ed ottimizzazione di tecniche di Machine Learning per l'identificazione di particelle in esperimenti di fisica delle alte energia e per missioni spaziali" L'attività prevede lo sviluppo e l'ottimizzazione di tecniche di Machine Learning per l'identificazione di particelle cariche come pioni, kaoni, protoni, muoni ed elettroni, sulla base della risposta dei rivelatori, per un esperimento di fisica delle alte energia ai collisori attuali e/o futuri da applicare nel contesto del Centro Nazionale di Ricerca in HPC, "Big data" e "Quantum Computing", Piano Nazionale di Ripresa e Resilienza". Si intende esplorare ed ottimizzare l'uso di tecnologie software e hardware (testbeds) per il training di pipeline di Machine Learning a larga scala, che fanno uso particolarmente intenso dei dati ed estendendole stesse metodologie ai dati provenienti da osservazioni spaziali

5. INTER-UNIVERSITY Ph.D. (WITH UNIVERSITY OF BARI "ALDO MORO") IN INDUSTRY 4.0 – DRI4.0

Coordinator: Prof. Gennaro Boggia

Department of Electrical Engineering and Information Technology

INPS		
SCIENTIFIC SUPERVISOR	GRANTS AVAILABLE	TOPIC AREA
Prof. Andrea Listorti	1	Production of green hydrogen by photocatalysts based on halide perovskites and fullerene derivatives.
Prof. Francesco Dell'Olio	1	Advanced training and research in the field of interdisciplinary technologies enabling the 4.0 paradigm.
Prof. Vito Modesto Manghisi	1	Human performance envelope and adaptive augmented reality support systems.

Art. 3: ADMISSION REQUIREMENTS

Admission applications, with no age limit or nationality restrictions, may be submitted by all candidates who:

- by deadline date **hold one of the following degree qualifications** (second-level degrees);
 - degree awarded by an Italian university prior to Ministerial Decree 509 (1999);
 - Specialist degree as per Ministerial Decree 509 (1999);
 - Master's degree as per Ministerial Decree 270 (2004);
 - equivalent academic qualifications obtained abroad.
- obtain the qualification** required for admission by 31 March 2023;
- hold a second-level degree awarded abroad** (as per the Bologna Process) or a Master's degree which enables the holder to enrol on a PhD programme in their country of origin. These qualifications must be awarded by an officially recognized academic institute.

IMPORTANT: in order to compete for the assignment of an **INPS** grant, according to the agreement approved with Rectorale Decree no. 1392/2022 between Politecnico di Bari and INPS, the candidate must comply with the following requirement: be the child or orphan of an employee or retiree registered in the *Gestione Unitaria delle prestazioni creditizie e sociali* or of a retiree user of *Gestione Dipendenti Pubblici* (mandatory self-certification, see art. 5).

Only for those candidates due to graduate from Politecnico di Bari, Ph.D. programme applications may only be submitted after an online request for second level qualification conferment has been made, as per administrative regulations and deadlines issued by the Politecnico *Centro Servizi per la Didattica*.

Candidates whose degree has **already been recognised as equivalent** by an Italian university must attach self-certification indicating all relevant details of this to their application.

Where a qualification awarded by a foreign university has **not yet been declared equivalent** to an Italian university degree, the Selection Committee will decide upon the eligibility of the foreign qualification in line with current Italian regulations and those of the country of origin, as well as any international treaties or agreements on qualification recognition for further study. In order to facilitate the recognition process, candidates must attach all documents pertinent to eligibility evaluation to their online applications. The compilation of online applications entails an implicit request for the verification of all degrees awarded abroad.

The evaluation of qualification eligibility is only possible if the documentation provided clearly shows all required information, including **specific details** (degree type; typical length of degree course; official title of academic institute awarding the degree; date qualification obtained; mark or grade achieved in relation

to the scale used in the higher education system in question).

Candidates are accepted provisionally until the validation of all admission requirements. Politecnico di Bari may ascertain the fulfilment of these requirements at any time, also after programmes have commenced, as per art. 43 of Consolidation Act 445/2000. Candidates may be excluded at any time by substantiated decision.

Art. 4: APPLICATIONS

Applications for admission to the Ph.D. programmes outlined above can be made exclusively online **starting from Wednesday, 15 Feb 2023, 09:00, till Friday, 17 Mar 2023, 13:00 (mandatory deadline)**, using the procedures available on **PICA portal** (*Piattaforma Integrata Concorsi di Ateneo*) available at the following link <https://pica.cineca.it/poliba/dottorati-pnrr-23-01/>.

The access to the procedure takes place on PICA portal and it can be carried out after registration or with SPID credentials, as indicated in the Guidelines ([link to the manual](#)). In case of technical problems before and during the registration procedure, it is possible to contact the dedicated technical support, at the link indicated within the application session interface (PICA HelpDesk is active from Monday to Friday, from 9:00 to 17:00).

Instructions for the specific requirements for each PhD programme can be found in Art. 3 of this call document.

Any applications that are presented in different formats will not be considered.

Candidates are responsible for correct adherence to online procedures.

Candidates are invited to apply for the selection procedure in advance of the final deadline date. At the end of the procedure, the application will be registered and confirmed via e-mail by the system.

During the application procedure, candidates must:

- **upload, in pdf format, documents** required within art. 5;
- **pay the administration fee of € 30,00**. The candidate must pay the fee by clicking on "*Paga con Pago PA*" button ([link to the manual](#)) and choosing the following method of payment:
 - Credit/debit card: for payment by card;
 - Current account: for direct debit to your account;
 - Any other payment methods and circuits that allow the fulfilment of PagoPA notices.

Only for candidates resident abroad: if it is not possible for candidates to pay using the PagoPA system, payment will also be accepted by bank transfer payable to: Politecnico di Bari - via G. Amendola, 126/B - 70126 Bari. The bank details are: IBAN: IT59X0306904067100000300001 BIC: BCITITMM - description: "Application for PhD Programme in ____". Only those candidates making payment in this way are required to upload - within the online application - attaching a copy of the bank transfer payment along with a declaration of failed administration fee payment (*Dichiarazione di impossibilità al pagamento del contributo di partecipazione alla procedura concorsuale mediante PagoPA*), to be compiled using the form available on the Politecnico website (<https://www.poliba.it/it/dottorati-di-ricerca>).

Under no circumstances can refunds be issued (i.e. exclusion, withdrawal, absence, etc.).

The sole fee payment of € 30,00 does not in itself constitute an application in the absence of an online application form. All conditions of the application procedure are obligatory and candidates

who fail to comply will be excluded from the selection procedure.

As part of the online application, **candidates with a disability** (as per Laws 104 (5 Feb 1992) and 17 (28 Jan 1999) or specific learning disabilities (SLD / ASD as per Law 170 (8 Oct 2010) must clearly state any request for additional assistance or added time needed to complete the examination.

Applicants who intend to **apply for more than one PhD programme** must do so separately for each programme, providing the documents and qualification certificates required for each programme selection procedure. Each programme application requires a separate application procedure (including payment).

Within the deadline and up to the confirmation of the application, it is possible to modify, cancel and insert data and attachments. Afterwards the confirmation, before the deadline, it is possible to withdraw the application and submit a new one.

After the deadline and/or after the confirmation of the application on PICA portal, it is not possible to add documents and modify the application.

Verification of application validity, including receipt of all required documentation and compliance with self-certification requirements, will be carried out by the Administration Department after the deadline date.

Art. 5: DOCUMENTS TO ATTACH TO APPLICATIONS

During the application (see art. 4), it is **obligatory** the upload of the following documents (**failure to comply will result in exclusion from the selection procedure**):

- A CV following the **example format** provided by Politecnico di Bari on the Politecnico website www.poliba.it in the *Ricerca/Dottorati di Ricerca* section.
- **A signed, valid identification document. Only the following documents will be considered;**
 - Only ID cards issued by an EU member state;
 - Only driving licences issued by an EU member state;
 - In all other cases, a fully valid passport (including non-EU citizens);
- **Degree qualification certification for first (Bachelor) degrees and second (specialization/Master's) degrees (or 5-year Single Cycle degrees). Candidates with qualifications obtained in Italy must** attach the form provided by the Politecnico and available at the link <https://www.poliba.it/it/dottorati-di-ricerca> specifying the following information:
 - final degree marks;
 - list of exams taken during both degree courses (or single, 5-year course);
 - marks for exams taken.

Candidates with a **degree qualification awarded by a non-Italian university**, in place of self-certification, must attach the following documents to their application, prepared by the academic institute which issued them:

- Degree certificate or diploma showing relative final mark;
- Official transcript of exams taken during all university study programmes, showing relative results;
- Any other type of document which demonstrates the equivalence of qualifications with those required in this application call (Supplementary Diploma, *Dichiarazione di Valore*) issued locally.

- **An abstract/summary of the thesis topic for specialist/Master's degree (or five-year Single Cycle degree)**, stating the title and name of thesis supervisor(s) (max 3,000 characters)
- **The candidate's thesis for specialist/Master's degree (or five-year Single Cycle degree)**; for graduating students whose thesis is not yet complete (see art.3), a draft version of the thesis which has been completed up to the time of application; (N.B. *draft version* implies a version of the thesis text written by the graduating candidate up to the date of application, which, in terms of chapters and pages, allows the Selection Committee to

evaluate its relative content and subject area. The abstract is not considered as a draft version of the thesis under any circumstances.

- **PhD research proposal** which the candidate intends to develop during the programme, stating the scientific basis of the proposal, its research objectives and the methods to be used. **Proposals must be based on the relevant topic areas outlined in this Call document.** Proposals are assessed purely as part of the selection procedure and are not necessarily those which candidates will develop during the programme.
- **(only for candidates who want to compete for an INPS grant) – Self-declaration** in which the candidate declares to be the child or to be orphan of an employee or retiree registered within *Gesione unitaria delle prestazioni creditizie e sociale* or a retiree user registered within *Gestione Dipendenti Pubblici*.

Other **non-obligatory** attachments to the application to facilitate the selection process may include the following:

- **A self-certification declaration for any other qualification deemed** suitable for evaluation, which must be signed and dated (form available at the link <https://www.poliba.it/it/dottorati-di-ricerca>), in accordance with arts. 46 and 47 of Presidential Decree 445/2000.
- **Language certification** demonstrating a knowledge of English which corresponds to at least B2 level. Only non-Italian citizens can attach certification which demonstrates knowledge of the Italian language.
(*This file should be named "10.Certificazione linguistica 1"; etc*).
- **Any publications** related to activity carried out and shown on the candidate's CV. All of the aforementioned documents must be in either Italian or English or translated into Italian or English, under the responsibility of the candidate.

The candidate, after submitting the application, will be able to see in the dashboard the button "**Lettera di referenza**" (**Reference/Recommendation Letter**), useful to send the request of a reference letter (max. 2 letters – not mandatory). For this function, the candidate must indicate, within the form, the institutional email address (not a private one) of the person involved that will be notified by PICA system regarding the reference letter compilation. If the person involved decides to issue the letter for the candidate and completes the procedure, PICA system will notify the candidate regarding the complete activity. Afterwards, it will not be possible anymore to access to that reference letter request, it will be only possible to withdraw it and submit a new one. In any case, the candidate can access to the system and check the request status. **ATTENTION:** the involved person shall submit the reference letter not later than the end of the call (17 Mar 2023, 13:00).

It is specified that, according to D.P.R. no. 445 (28 Dec 2000), in case of events, status and/or qualifications certified by **Italian Public Administrations**, it is only admitted the upload of a personal declaration of certification.

Art. 6: GROUNDS FOR EXCLUSION

The following are grounds for exclusion from the PhD programme selection procedure:

- any application which does not comply with the format set out under art. 4 of this call document;
- incomplete applications or those containing errors or missing documents which are obligatory for the selection procedure, as set out in art. 5, relative to each individual PhD programme;
- any false or mendacious self-declaration statements.
- missing application fee payment by the deadline date, as set out in the terms under art. 4.

Any candidates excluded from the selection procedure will be notified by Post-Lauream Office by email at the address provided during the registration on PICA portal. As such, candidates are asked to verify that the

email address provided on the application form is current and correct. Alternative email addresses sent separately will not be taken into consideration.

Art. 7: PUBLIC EXAM PROCEDURE

Admission to the PhD programmes is subject to a selection procedure designed to ascertain candidate preparation on general programme topics and their research aptitude and is aimed toward ensuring an accurate comparative evaluation of candidates.

The Evaluation Board will issue the list of the candidates admitted to the oral exam, according to criteria established within art. 8. Before the oral exam, candidates will be informed about the marks obtained, through Politecnico di Bari website.

At the end of the oral exams, the evaluation Boards will issue the lists of candidates with the indication of marks for each candidate. The final marks will be published on the webpage dedicated to Ph.D. programs of Politecnico di Bari.

Oral exams will take place 27 March and 28 March 2023. Oral exams will be held in line with instructions provided to candidates prior to the test, published in the *Dottorati di Ricerca* page of the Politecnico di Bari website (www.poliba.it). Candidates will be excluded from the selection procedure if they are unable to provide identification or do not attend on the day of the selection examination.

All candidates must demonstrate a good knowledge of English. This can be certified with a recognised language qualification from an accredited examination board showing B2-level knowledge of the language, in line with the Common European Framework for the Knowledge of Languages. In the absence of certification, the candidate's English language level will be assessed during the oral examination.

Non-Italian candidates must demonstrate a satisfactory knowledge of Italian. On submission of the application form, this can be certified with a qualification showing B1-level knowledge of Italian, in line with the Common European Framework for the Knowledge of Languages. In the absence of certification, the candidate's Italian language level will be assessed during the oral examination.

Examinations can be taken either in Italian or in English for those candidates who request this option in the online application.

Any changes relating to the aforementioned dates or times **will be published** as an official notification on the *Albo Ufficiale* page, as well as on the Politecnico website. **No other form of notification regarding oral examinations will be sent to candidates.**

Art. 8: EVALUATION OF QUALIFICATIONS AND INTERVIEW

The Examination Board will assess candidates' qualifications and interview with a **mark out of 100**.

- a. For **DRIEI, DRSATE** and **DRI4.0** PhD programmes, this total mark is divided as follows:
 - 40 marks for qualifications held (average exam marks, final degree mark, theses, Master's degrees, post-graduate courses, language certification, publications, etc.)
 - 60 marks for interview.

Candidates obtaining less than 10 marks in the **qualification evaluation** stage will not be admitted to the interview. The minimum pass mark for the **interview** stage is 15.

- b. For **DRIMEG** and **DRISA** PhD programmes, the total mark is divided as follows:

- 20 for qualifications held (average exam marks, final degree mark, theses, Master's degrees, post-graduate courses, language certification, publications, etc.);
- 20 for the research project proposal.
- 60 for the interview (which provides a complete evaluation of the candidate and verification of the applicant's aptitude for research and willingness to undertake experience abroad, as well as areas of research interest.).

Candidates obtaining less than 10 marks for **qualification evaluation** will not be admitted to the research project evaluation stage. The minimum pass mark for the **research project evaluation** is 10. The minimum pass mark for the **interview** is 30.

At the end of the examination procedure, the Board will carry out an overall assessment and draw up an admission rankings list on the basis of the marks obtained by candidates in each part of the examination. The **assessment criteria for qualifications** will be established by each Evaluation Board.

Art 9. SELECTION BOARD AND GRANT ALLOCATION

The Rector will appoint an Evaluation Board with a Rector's decree as per art. 15 of the Politecnico di Bari's PhD Programme Regulations (available on the Politecnico website).

Members of the Selection Board are required to provide self-certification under art. 46 of Presidential Decree 445/2000 attesting that:

- they will advise of any potential conflict of interest in the selection procedure and/or reasons for abstention or incompatibility with regard to their appointment.
- they do not have a criminal record for acts which excludes them from holding public office, acts which influence professional moral standards or acts as set out in Legislative Decree no. 231/2001;
- they are not currently aware of being under criminal investigation.
- they will carry out their duties in an impartial and professional way, respecting confidentiality and adhering to the current regulations and founding principles of the Politecnico's Ethical and Behavioural Code.

The Selection Board will draft an examination report which will then be submitted to the Post-Lauream Office to provide admission rankings lists for each of the PhD programmes.

Grant allocation will be administered by the Professors Board of each individual PhD programme.

ART. 10: ADMISSION RANKINGS AND ELIGIBILITY

The Rector will issue a decree confirming his approval of the acts and the general ranking list and declaring the list of winners, with grants indication (*Decreto di Approvazione Atti and Assegnazione Borse*).

Candidates are admitted to the courses in the order of admission rankings until all available positions have been assigned for each programme.

In cases where candidates have an identical result, gender balance will be considered, with preference given to the minority gender with higher ranked positions in the same list. If candidates are still level, the younger of the candidates will be selected as the beneficiary.

The general admission ranking list for successful candidates (*Decreto di Approvazione Atti and Assegnazione Borse*) will be published online as with an official notification on the Official Notifications (Albo Ufficiale) page of the Politecnico di Bari website, as well as in the specific section of www.poliba.it.

ART. 11: ENROLMENT

Candidates admitted to PhD programmes must enrol online according to the terms and modalities that will be communicated within a dedicated Notice published on the *Albo Ufficiale* of Politecnico di Bari.

The terms and regulations for enrolment will be published at the same time as the admission ranking list as an official notification on the Albo Ufficiale page of the Politecnico di Bari website, as well as in the Ricerca/Dottorati di Ricerca section of www.poliba.it. This notification will also be attached to the *Decreto di Approvazione Atti and Assegnazione Borse* documents.

Candidates who fail to enrol as set out under these regulations for successful applicants will be considered as having waived their status as a successful candidate. This waiver will affect any subsequent entries on the admission ranking list and rulings which may arise as a result.

The notification attached to the *Decreto di Approvazione Atti and Assegnazione Borse* document will outline terms and conditions for any subsequent rulings.

Please note that candidates will be given a deadline to implement these procedures, after which failure to reply or comply with the terms will be considered as withdrawal from the rankings.

If a successful candidate waives their position or loses their right to admission before the beginning of the PhD programme, a replacement participant will be admitted according to their position on the admission rankings list. If a candidate is deemed eligible for more than one programme, he/she must opt for only one of these.

Please note that if a study grant is waived at any time during the programme, the participant's status as PhD student is annulled.

If a place on the PhD programme is waived after completing the enrolment process, a stamp duty fee of €16 must be paid.

ART. 12: OBLIGATIONS AND RIGHTS OF DOCTORATE RESEARCH STUDENTS

Participation in the PhD programme is a full-time commitment subject to a specific discipline, in accordance with art. 10 of the Doctorate Research Programme Regulations issued as part of Politecnico di Bari Rector's Decree no. 288 (11 Mar 2022).

Doctorate Research students are hereby notified of their obligation to respect:

- the rules and conditions set out in the Doctorate Research Programme Regulations, issued as part of Rector's Decree no. 288 (11 Mar 2022);
- the Politecnico di Bari's Ethical and Behavioural Code, issued as part of Rector's Decree no. 582 (28 Sept 2018);
- all applicable rules and Politecnico di Bari regulations, including those pertaining to student fees as stipulated by the Politecnico di Bari.

Doctorate students are required to provide documents as stipulated in "Guidelines for accountability for initiative implementors for Mission 4 Component 2":

- report on time schedules;
- periodic reports on principal activities carried out, counter-signed by the scientific supervisor;
- annual report;
- documentation of research activities carried out;
- all payment documentation.

ART. 13: GRANTS

The full amount of the scholarship, paid in monthly instalments, is equal to €16.243,00. This figure is gross and subject to social security contributions, which are to be paid by the beneficiary. This amount may be increased by up to 50%, allocated monthly for a period of 12 months if authorisation has been given by the programme Coordinator to carry out research activity abroad. This period may be extended to a maximum of 18 months for PhD students in joint co-ordination with external bodies or those established according to the Politecnico di Bari Regulations for Doctorate Research Programmes.

Grants are annual and are renewable on the provision that the student has completed the programme of activities for the previous study year. This is verified in accordance with procedures set out in the Regulations document, on the understanding that grants must be issued once verification has been successfully carried out.

All participating PhD students are ensured (as part of the financial resources of the Politecnico budget) a fund for research activity in Italy or abroad which is appropriate to their programme. This funding is no less than 10% of a total grant amount.

Doctorate Research grants may not be added to other types of funding (including research scholarships), except those granted by Italian or non-Italian institutes to provide support to PhD students abroad (with the exception of grants for further training abroad, as per Law 398).

Please note that the annual personal income established by Politecnico di Bari as compatible with grant allocation is €20,036.23. This includes property income as well as any other source of recurring income, with the exception of occasional work. Should this limit be surpassed, the candidate will be obliged to refund any instalments already paid for the fiscal year in which the amount of € 20,036.23 was exceeded.

ART. 14: FEES AND CONTRIBUTIONS

Upon enrolment on the programme, PhD students are subject to the current Student Fees and Contributions Regulations. These are available for consultation on the Politecnico website www.poliba.it.

PhD students are exempt from the all-inclusive contribution and are required to pay only the electronic revenue stamp and the ADISU Right to Higher Education fee, as well as adhering to the conditions set out in the Politecnico di Bari Fee Regulations.

The enrolment fee is €136, based on a stamp duty of €16 and the first instalment of Regional Tax (€120). ADISU fees are divided into three bands according to annual income, which are respectively €120, €140 and €160. Accordingly, based on the aforementioned ISEE figure, contributions will be invoiced in the private area of each PhD student. All payments must be made using the PagoPA electronic payment system. Payments made this way will be automatically recognised by the EssE3 system

Politecnico di Bari automatically acquires Equivalent Financial Situation Index certification (ISEE) from the National Social Insurance Agency (INPS) relative to subsidised benefits for higher education study in order to determine the total amount of Regional ADISU fees payable. All declarations should be completed in full

on the INPS website by 31 December of the calendar year of enrolment (for Academic Year 2022/23 the deadline will be 31 Dec 2022). Failure to provide declarations by the deadline date will result in the application of the full fee rate.

The up-to-date financial contributions of Doctorate Research students are an obligatory condition in order to access Politecnico services and maintain PhD student status.

ART. 15: TREATMENT OF PERSONAL DATA

In accordance with Law 675/96, the private nature of information provided by candidates will be guaranteed. All data provided will be used only for the purposes connected with selection procedures. For successful candidates, this data will also be used for purposes related to the PhD programme, in compliance with current regulations as per European General Data Protection Regulations EU2016/679.

Under arts.15-18 of the aforementioned Regulations, candidates have the right to access their personal data as well as request modifications, additions and cancellation. Candidates may also request limits for the treatment of their data by contacting the Politecnico di Bari at rpd@poliba.it.

In all cases, by participating in the selection process applicants give their implied consent for the publication of their data, including examination results, on the Politecnico di Bari website, in line with the abovementioned Law.

In accordance with Law 241 (7 Aug 1990) and Presidential Decree 184 (12 Apr 2006) and subsequent modifications and additions, any party with a related legal interest may have access to the selection procedure documentation, in line with guidelines set out under current legal rules. Accordingly, any documentation provided by applicants may be made available to other candidates.

ART. 16: PROCEDURAL SUPERVISOR

The Procedural Supervisor for selection proceedings is Ms. Simona Del Vecchio, Politecnico di Bari Research, International Relationships and Post-Lauream Office, whose contact details are: post-lauream@poliba.it, telephone (+39) 080 596 followed by 2229 / 2201 / 2525 or 2068.

ART. 17: REFERENCE FOR REGULATIONS

For any conditions not specified in this document, please refer to current regulations as well as those outlined in the Politecnico di Bari's Regulations for Doctorate Research programmes, issued as part of Rector's Decree 288 (11 Mar 2022).

This call for applications has been published on the website of the Italian Ministry of Universities and Research, Euraxess and the Official Notifications page of the Politecnico di Bari's website (www.poliba.it) and its *Ricerca/Dottorati di Ricerca* section.

Bari, 14th February 2023

The Rector
Prof. Francesco CUPERTINO

ATTACHMENT 1

“SYSTEMS AND TECHNOLOGIES FOR FINAL USES”

“Network 4 Energy Sustainable Transition” (NEST)

Spoke 4 - “Clean Hydrogen and Final Uses”

(Resp. Scientifico: Prof. Marco Torresi – Referente Borsa: Prof. Marco Torresi)

Recent EU policies and Italian PNRR identified hydrogen (H₂) as key enabling energy vector for National/EU future. In this sense, Italy needs to promote a new economic paradigm, where H₂ will become one of the pillars of the next future decarbonized energy production. The use of H₂, either directly or through derivatives such as ammonia (NH₃), presents important technological problems, but in perspective, offers great margins for improvement in different industrial and energy applications.

Hydrogen addition (or complete substitution) to conventional fossil fuels increases the reactivity and the flame speed of the mixture, causing higher temperature in the combustion chamber and thus higher NO_x emissions. In this context, a more detailed understanding of the effects of hydrogen addition to traditional fossil fuels on the mixture properties, and thus to the whole combustion process, is crucial.

The PhD student activity will be focused on the development of accurate numerical simulations of the combustion of hydrogen, ammonia and blends of conventional fossil fuel and hydrogen.

The research activities will take place within the Sustainable Mobility Research Lab of Polytechnic University of Bari with reference to the Spoke 14 facilities as well as in the laboratory of the Department of Mechanics, Mathematics, and Management (DMMM) of the Polytechnic University of Bari.

The ideal candidate for this position is an engineering with background in energy systems. It must also demonstrate an aptitude for teamwork and develop a critical and investigative spirit in the research topic.

ATTACHMENT 2

“ENHANCE THE ADDITIVE MANUFACTURING KNOWLEDGE AND USABILITY FOR MULTIMATERIAL APPLICATIONS”

“Sustainable Mobility Center” (MOST)

Spoke 11 - “Innovative Materials and Lightweighting”

(Resp. Scientifico: Prof. G. Palumbo – Ref. Borsa: Prof. G. Casalino)

Today, the use of innovative materials requires the valorization of traditional manufacturing techniques and mechanical design through advanced experimental investigation methods with a focus on the application of modern experimental mechanics and soft modeling for process optimization.

This is the case of additive manufacturing, which is increasingly recognized for its large-scale part production. An enabling technology characterized by the integration of cyber and physical spaces, called Digital twin (DT), fits well with WAM as it can make use of digitized resources and data analysis for process optimization and control.

This is the case of additive manufacturing, which is increasingly recognized for its ability to produce large-scale parts. An enabling technology characterized by the integration of cyber and physical spaces, called Digital twin (DT), fits well as it can make use of digitized resources and data analysis for optimization and control.

The doctoral proposal involves a systemic study of additive manufacturing, including new processes and materials, training of personnel, and dissemination of additive manufacturing methods to industrial, educational, and recreational sectors.

The doctorate will be carried out at the Hybrid Welding advanced materials welding laboratory

<https://www.dmmm.poliba.it/index.php/it/laboratori/laboratorio-di-hybrid-welding> and the Intelligent Computing for Manufacturing Processes laboratory

<https://www.dmmm.poliba.it/index.php/it/laboratori/laboratorio-di-calcolo-intelligente-per-i-processi-di-fabbricazione-e-i-sistemi-di-produzione-cisp>.

The candidate for this position preferably has a mechanical/management engineering background with a focus on advanced and innovative production processes. A marked interest in the use of innovative technologies will be a preferential asset.

ATTACHMENT 3

“PROGETTAZIONE MECCANICA DI SUPERFICI ADESIVE MICRO-STRUTTURATE MEDIANTE STRUMENTI DI BIG-DATA ANALYSIS”

SURFACE (EUROPEAN RESEARCH COUNCIL)

(Resp. Scientifico: Prof. Antonio Papangelo)

The research proposal aims to develop techniques based on big-data analysis for the optimal design of micro-structured polymeric adhesive surfaces in order to develop numerical tools useful for the design of adhesive interfaces in robotics. The research object finds application in the field of soft robotics, in particular for the development and design of grippers, manipulators and adhesive pads. This field of application of grasping technologies is rapidly growing due to the fast industrial transition taking place in the last decade aimed at replacing metal robots with soft robots made of polymeric material, capable, among other things, of interacting directly with human beings without being harmful. The optimal design of micro-structured

adhesive surfaces passes through the definition of the geometry, at the macro- and micro/nanometric scales, from the choice of materials and their properties, to the strategy used for implementation (load, displacement control). Given the complexity of the problem, the research project aims to develop methods suitable for processing large datasets, such as machine learning techniques, to which, however, it is possible to add "constraints" determined by construction needs, of the design, or simply related to the physics of the problem. The project will therefore plan to: (1) determine the most suitable numerical methodology for the simulation of the contact interface (finite elements, boundary elements, atomistic simulations), (2) populate a sufficiently rich and varied database to be used for training neural networks, (3) validate the results obtained from the neural network through numerical test cases developed ad-hoc, (4) compare the numerical results obtained with experimental measurements. The research project will be carried out in collaboration with the Technical University of Berlin, in particular with the Cyber-Physical Systems in Mechanical Engineering group, which the researcher will be able to visit for a research period abroad of a maximum duration of 18 months in order to sharpen his/her skills in the field of big data analysis. For the experimental measurements, the researcher will make use of the instrumentation and competences of the TriboDynamics group, in particular regarding the possibility of designing and fabricating micro-structured interfaces in polymeric material with a resolution of the order of about 200 nanometers at the TriboDynamics Lab, funded within the research project “SURFACE” ERC-2021-StG (Grant agreement ID: 101039198).

ATATCHMENT 4

“INTEGRATION OF CONTROL – ORIENTED MODELING AND OPERATIONAL OPTIMIZATION FOR THE IMPROVEMENT THE USE OF THE SHALLOW GEOTHERMAL ENERGY”

“Network 4 Energy Sustainable Transition” (NEST)

Spoke 2 - “Energy Harvesting and Offshore Renewables”

(Resp. Scientifico: Prof. Sergio Camporeale)

Referenti Borsa: Prof.ssa Concetta Immacolata Giasi, Prof. Nicola Pastore)

Il riscaldamento degli ambienti, nonché la produzione di acqua calda sanitaria rappresenta quasi il 33% del consumo energetico europeo. In linea con le recenti politiche Europee e del PNRR, le pompe di calore geotermiche sono tecnologie ad alta efficienza energetica per il riscaldamento, la produzione di ACS nonché il raffrescamento estivo. Si stima che nel UE si possono risparmiare 520 TWh di energia primaria nonché la riduzione di 157 Mt di CO₂ all'anno sostituendo le caldaie a gas naturale con le GHSPs riducendo così la dipendenza dal gas naturale da fonti extra UE. Il futuro sistema energetico necessita di sistemi di immagazzinamento termico per gestire le variazioni della domanda e dell'offerta di calore e raffreddamento a diverse scale, ma soprattutto i cali stagionali e i picchi di richiesta di calore. Per l'immagazzinamento termico stagionale su larga scala il sottosuolo offre grandi potenzialità per l'immagazzinamento di energia termica, risultando stabile a lungo periodo.

Una delle tecnologie per l'harvesting geotermico è rappresentato dai geo scambiatori di calore con il sottosuolo. La principale barriera all'ampio utilizzo di questa tecnologia è rappresentata dagli alti costi di installazione principalmente dovuti a costi delle perforazioni che incidono del 70% sul costo totale dell'impianto geotermico.

L'attività del dottorando sarà focalizzata sullo sviluppo di accurate simulazioni numeriche nonché indagini sperimentali per lo studio e lo sviluppo di nuovi sistemi e tecnologie di scambio termico, nonché del loro impatto sull'ambiente a breve ed a lungo termine.

Le attività si svolgeranno presso il laboratorio del Partenariato Esteso NEST con specifico riferimento allo Spoke 2 e presso i laboratori di Geoingegneria Ambientale del Dipartimento di Ingegneria, Civile, Ambientale, del Territorio, Edile e di Chimica (DICATECh) del Politecnico di Bari.

Il candidato ideale per questa posizione dovrà avere una formazione di tipo ingegneristico nel campo ambientale. Deve inoltre dimostrare di conoscere il tema della geotermia a bassa entalpia, deve avere attitudine al lavoro di gruppo e allo sviluppo di spirito critico e investigativo nella tematica di ricerca.