PHD PROGRAMME TABLE 38TH CYCLE

Section "Available Positions and Scholarships" integrated on 19/05/2022

Section "Admission Exams" integrated on 13/06/2022

PROGRAMME'S NAME	HEALTH AND TECHNOLOGIES
DURATION	3 years
PROGRAMME START DATE	01/11/2022 (DD/MM/YYYY)
LANGUAGES	Italian, English
MANDATORY STAY ABROAD	3 months
COORDINATOR	Prof. Marco Viceconti (marco.viceconti@unibo.it)
CURRICULA	N/A
RESEARCH TOPICS	Detailed list at the bottom of the present document
PhD POSITIONS	8
ADMISSION PROCEDURE	Qualifications and research proposal evaluation Oral examination

Available Positions and Scholarships

Pos. n.	Financial Support	Description	Positions linked to research topics
1	PhD Scholarship	Totally funded by the University of Bologna general budget	A research topic chosen among those listed at the end of the present document
2	PhD Scholarship	Totally funded by the University of Bologna general budget	A research topic chosen among those listed at the end of the present document
3	PhD Scholarship	Totally funded by the University of Bologna general budget	A research topic chosen among those listed at the end of the present document
4	PhD Scholarship	Co-funded by the University of Bologna general budget and by the Department of Industrial Engineering	A research topic chosen among those listed at the end of the present document
5	PhD Scholarship	Co-funded by the University of Bologna general budget and by the Department of Industrial Engineering	A research topic chosen among those listed at the end of the present document
6	PhD Scholarship	Funded by the Department of Industrial Engineering	Modelling suboptimal muscle control in patients with Parkinson's disease. Tutors: Prof Marco Viceconti (TECH), Prof. Dr. med. Walter Maetzler (MED)
7	PhD Scholarship	Funded by the Department of Experimental, Diagnostic and Specialty Medicine partly with funds made available by the project Horizon 2020 "In Silico World: Lowering barriers to ubiquitous of In Silico Trials – ISW", G.A. n. 101016503 project code (H2020_ISW_CASTELLANI) (Vincolo n. 12288/2022)	Integration of multiomic data with imaging by statistical and machine learning techniques
8	PhD Scholarship	Funded by the Department of Industrial Engineering with funds made available by the Project H2020 ISW "In Silico World: Lowering barriers to ubiquitous adoption of In Silico Trials" – G.A.	Development of an in silico model of osteoporosis drug treatments. Tutors: Prof Marco Viceconti (TECH), Prof. Francesco Papparldo (MED)

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		101016503 – Ref. Prof. Marco Viceconti - CUP J59C21000480006	

Admission Exams

	DATE AND TIME	RESULTS
Qualifications and research proposal evaluation	Applicants' participation is not required	Available from **22/06/2022****
Oral examination	**Date**: starting from ~~**29/06/2022**~~ **30/06/2022** – ~~**10.00**~~ **9.30 a.m. CEST*** **Place**: In presence, ~~Aula Pisi - Pad. 11 – ground floor, Sant'Orsola Malpighi, Via Massarenti 9~~, **Aula Magna, Via San Giacomo 14, Bologna**. Remotely, using Microsoft Teams	Available from **05/07/2022****

* In case that the oral examination cannot be completed in one day due to the large number of applicants, the oral examination detailed schedule shall be made available on the webpage Studenti Online together with the results of the qualifications and research proposal evaluation. **During the oral examination, applicants may express their interest in one or more positions linked to specific research topics.**

** The **results of the admission exams** will be available on the webpage Studenti Online (select "summary of the requests in progress" > "see detail" and open the .pdf file at the bottom of the page). **No personal written communication will be sent to applicants concerning the examinations results**.

Required and Supporting Documents to be attached to the application

All the documents listed below **shall be drawn up in English or in Italian**. In case of documents originally issued in any other language (e.g. identity document, qualifications), an official English translation is required.
Only qualifications obtained **during the last 5 calendar years** shall be taken into consideration, except for the University Degree. The Admission Board will assess the relevance of the supporting documents to the PhD Programme.

REQUIRED DOCUMENTS	
Identity document	Valid identity document with photo (i.e. identity card, passport)
Curriculum Vitae	The Europass format is required
Degrees	Documents attesting the awarding of the first and second cycle degrees, the exams taken and the marks obtained (see Art. 3 of the Call for Applications)
Research proposal	Multi-annual research proposal, with special emphasis on the **activities to be completed during the first-year course**. The proposal must meet the following requirements: - it must **mention on the cover page one of the research topic assigned to a specific PhD position or one of the research topics available for positions 1-5, detailed at the end of the present document**; - **it cannot exceed 20,000 characters**, including spaces and formula possibly used. This figure does not include: the title of proposal, the outline, references and images (such as graphs, diagrams, tables, etc. - if present); - **it must include**: the state of the art; description of the proposal; expected results; articulation of the proposal and implementation times; outlining of the criteria meant to be used to assess the research results.
SUPPORTING DOCUMENTS	
Thesis abstract	Abstract of the **second cycle degree thesis.** Graduands applicants may submit the draft of the thesis. Abstracts cannot exceed 5,000 characters, including spaces and formula possibly used. The above figure does not include: the title of the thesis, the outline, references, and images such as graphs, diagrams, tables etc.
Reference letter/s	**No more than 2 reference letters** signed by Italian or international academics and professionals in the research field, which do not form part of the Admission Board, attesting the suitability of the applicant and his/her interest in the scientific research. Letters shall be uploaded following the procedure detailed in the Call for Applications (Art. 3.2)

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Personal Statement	The statement shall include the reasons prompting the applicant to attend the PhD Programme and **those relevant experiences and research interests**, that make the applicant suitable for the specific PhD Programme (3000 characters maximum, including spaces).
Publications	Lists of publications (i.e. monographs, articles on scientific journals), minor publications (conference papers, etc.), abstracts and posters presented during national and international conferences, etc.
Other documents	- Postgraduate vocational training programmes relevant to the PhD Programme main research topics - Specialisation thesis abstract (max 1,500 characters) - Teaching activities carried out at academic level - Research activity of any kind - whether basic, applied, translational, etc. - carried out in any capacity, including when covered by research grants, and as a staff member of research projects - Study periods completed by applicants outside their countries of origin (e.g. Erasmus programme or other similar mobility programmes)

Evaluation criteria*

Scores will be expressed in points out of 100, as follows.

1. Qualifications and research proposal evaluation

Minimum score for admission to the oral examination: 30 points, Maximum score: 50 points

Qualifications evaluation	Second cycle (Master's) degree final mark and Weighted Average Mark (WAM). Graduands shall be evaluated according to the Weighted Average Mark (WAM)	7 points max
	Publications	4 points max
	Second cycle thesis abstract	1 point max
	Reference letter/s	1 point max
	Research activity	3 points max
	Interdisciplinarity and balance between technical and clinical scope	6 points max
	Study or research periods abroad	3 points max
	Other evaluable documents	3 points max
Research proposal evaluation	Scientific value and ground-breaking nature of the proposal	18 points max
	Structure of the proposal	2 points max
	Proposal feasibility	2 points max

2. Oral examination

Minimum score for eligibility: 30 points, Maximum score 50 points

English language proficiency	10 points max
Research proposal presentation	20 points max
General knowledge of issues encompassed by the PhD Programme	20 points max

Oral examination aims to assess the suitability of the applicant for scientific research as well as the general knowledge of issues encompassed by the PhD Programme (see the list of research topics at the bottom of the present document).
During the oral examination, the applicant's English language proficiency shall be assessed.
The oral examination is carried out in English**.**
* Possible further evaluation criteria will be available on the University website, selecting the relevant PhD Programme > "More information", at the bottom of the page in the section "Notices".

Research Topics

- Biomechanics
- Neurocognitive system
- Diagnostics
- Therapeutics
- Methodologies
- Devices and services
- Analysis of processes and artificial intelligences

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Research Topics available for the positions 1-5

Topic	Subject	Title	Description
A	TECH	I-BLOSSOM - Instrumented Biomarkers for LOngitudinal aSSessment Of Motor control development	This project will focus on the provision of tools monitor motor development, to know when intervention is necessary, and what it should be. It is consistent with the acute needs in the field as evidenced by the World Health Organization and UNICEF pillars of needed action to "Monitor and evaluate early childhood development efforts" with the goal of "Early identification of developmental delays and/or disabilities" (WHO and UNICEF, 2012). Many challenges experienced by children with motor disabilities respond well to intervention if started early when brain plasticity is at its greatest. Biomarkers allowing the systematic longitudinal monitoring of motor control can support the prompt identification of deviations from the reference pathway, allowing to deliver timely effective interventions. I-BLOSSOM will develop instrumented methods for the effective identification of quantitative biomarkers of motor development in children, starting from birth to adulthood.
B	MED	Total ankle replacement optimization to improve clinical outcomes by the analysis of implant survival and causes of failure	Several risk factors are associated with poor clinical outcomes or failure of total ankle arthroplasty (TAA), and at present an unexpectedly high early revision rate of TAA implants is observed. A transdisciplinary approach might identify and evaluate the relevance of the different risk factors on TAA clinical outcomes and causes of failure: the hypothesis is that it is possible to improve the outcomes of TAA implants by understanding their modes and causes of failures. This would benefit from the adoption of already well-developed preoperative planning of TAA and the implementation of new strategies for ensuring joint stability and proper alignment of TAA throughout the leg axis. Pre-operative CT scans will be used to assess any joint deformity and, when deemed necessary, design patient-specific cutting guides. Data will be implemented by a detailed assessment of ankle laxity, possibly complemented by ultra-high field magnetic resonance imaging.
C	TECH	Development and perspective validation of an in silico methodology for the prediction of bone fracture risk to be used as clinical support system	Prof. Viceconti's team has been working on the construction of the Bologna Biomechanical Computer Tomography (BBCT) technology, a digital twin which, based on a QCT-informed computer model, can predict the risk of fracture for a specific bone district. Such tools have the potential to support the clinical decision concerning a specific anti-resorption treatment or medical device implantation. Currently BBCT technology applied to the femur site, BBCT-hip, can accurately predict the fracture risk at the femur at the time of the CT. In this context, the aim of this project is twofold: on one hand the expansion of BBCT clinical application to other skeletal sites (e.g. vertebrae) and on the other hand the development and implementation of an ageing model for naïve patients. We plan to start from a phenomenological and deterministic model to replicate bone mass change in physiological/pathological (osteoporosis) conditions and to achieve a more complex mechanistic model. In parallel, a perspective validation plan will be carried out to assess the credibility and accuracy of BBCT methodology.
D	TECH	A deep learning framework for unveiling multimodal neural signatures in the	Artificial intelligence is essential for improving etiological understanding, identifying dimensional biomarkers, and decomposing heterogeneity in various neurodevelopmental and neurological disorders using neuroimaging and EEG data. This research project aims at providing multimodal neural signatures for the understanding of

		Autism Spectrum Disorder	mental health in the autism spectrum disorder (ASD) through the development of a supervised, semi-, and self-supervised deep learning framework. In particular, this project will integrate MRI and EEG data to bridge the explanatory gaps regarding underlying mechanisms of mental health by using retrospective, multicenter, large-scale landmark international initiatives focused on ASD aimed at the constitution of a harmonized meta-dataset (> 7000 subjects) to be exploited for developing and validating deep learning models. The project will allow to contribute to unveiling the heterogeneity in ASD and predict individual trajectories over time.
E	TECH	Biomechanical evaluation of knee mechanical behaviour and interface stresses with a new concept of alignment for total knee arthroplasty (NEW-KNEE)	At least one knee replacement out of 5 are dissatisfactory due to continuous pain. This is mainly related to inadequate joint kinematics with the current paradigm for prosthesis alignment, causing painful patellar motions and poor balance of soft tissue. Recently, a different rationale has been proposed based on kinematical alignment (KA). This PhD student will work under the joint supervision of an orthopaedic surgeon focusing on knee replacement, and of two engineers with a background in biomechanical in vitro testing, and numerical modelling respectively. During these three years, the PhD student will develop a numerical to estimate how the knee joint loads are affected by implant positioning, and a series of in vitro tests to measure how this affects the implant-bone interaction.
F	TECH	Computational modelling of vertebrae affected by metastasis for clinical diagnosis	Vertebral metastases are neoplastic formations that could jeopardize the spine stability and trigger catastrophic events, like the paralysis of the patient. The current clinical tools aim to identify those metastases that can expose the patients to a high risk of fracture. However, these clinical tools have some strong limitations which reduce their effectiveness in stratifying patients with metastasis. Preventive diagnosis of the risk of fracture can be performed with mechanistic models which take into account the complexity of the bone/metastasis structure and provide a clear evaluation of the actual competence of the bone. This project aims to develop, validate, and apply finite element models based on clinical computed tomography scans to evaluate the patient-specific risk of fracture. Data (computed tomography images, magnetic resonance imaging, displacement/strain maps) obtained from experimental tests on human metastatic vertebrae will be initially used to generate and validate the models. Clinical data will be provided by clinicians to apply the computational models and to be compared with the current standard-of-care. Finally, a computational tool, applicable in the clinical practice, will be developed and it will define the risk of fracture in terms of competence of the metastatic vertebra with respect to an adjacent healthy vertebra of the same subject.
G	MED/TECH	Memory shaped and resorbable sutures for microsurgery	The research project aims to develop small-diameter (between 7-0 and 11-0 according to U.S.P. – 0.05 - 0.01mm) memory shaped biocompatible sutures suitable for ophthalmic microsurgery. Placing sutures in microsurgery is always a challenging skill: developing confidence with the microscope, the coordination between eye and hands and the specific properties of the material, such as tensile strength and knot security, are the main features that make this art very complex. Moreover, some surgical steps render suturing even more complex. For example, iris suture repair in iris traumas, where the suturing process is performed in a small chamber (the Anterior Chamber of the eye), or suture fixation of posterior chamber intraocular lenses (IOLs) oblige the surgeon to move in restricted spaces. Corneal surgery transplant represents another complex

			situation [1]. In this case, the suturing process is carried out respecting many features, like the strength tension of the knot, the depth of the suture in the donor cornea and the recipient bed. Last, the refractive outcome and the structural results are both essential aspects and depend on a good suturing process.
H	TECH	Non-thermal plasma-assisted processes for sanitation and preservation of nutritional quality of food	This project will focus on the study of an innovative treatment of food using cold atmospheric pressure plasma (CAP). Indeed, CAP, with its blend of reactive oxygen and nitrogen species (RONS), UV rays, and electric fields is known to be used for the inactivation of microbes. Moreover, the interaction of CAP with liquids leads to the production of plasma activated water (PAW), with a high content of RONS in the liquid phase, that are useful for the sanitation of foods. Thus, the use of CAP or PAW could be a novel and safe adjuvant strategy for the decontamination of foods. Nevertheless, it is still unclear if the use of CAP can induce effects on the point of view of the nutritional quality of matrices and guarantee safety for consumers. Thus, the project aims to fill the knowledge gap in this field.
I	TECH	Developing imaging biomarkers from contrast-enhanced CT images of hepatocellular carcinoma predicting the microvascular invasion (MVI) using clinical and radiomic features	Microvascular invasion is one of the primal causes of recurrence after surgical treatment of Hepatocellular Carcinoma (HCC). However, the preoperative detection of MVI is very difficult, this causing pitfalls in the surgical decision making and leading to useless liver transplantations. Some imaging tumour findings may suggest the presence of MVI, including tumour size and morphology of tumour margins, but none of them is accurately related to the histologic proof achieved post-surgery. Therefore, new detection and prognostic approaches are needed for improving the pre-operative detection of MVI and increasing the benefits of treatment options. To this purpose, medical image phenotyping, recently called “Radiomics”, has shown to be effective to extract imaging biomarkers, by analysing a high number of features through machine learning methods. This project aims at detecting imaging biomarkers by setting up retrospective studies on cohorts of patients from IRCCS - S.Orsola-Malpighi Hospital (SOH) to select most promising radiomic features among those conceived by the Computer Vision Group (CVG) of DISI, to be subsequently validated with prospective studies. Finally, the reproducibility of biomarkers is assessed with a multicentre study, also involving the collaborating hospitals.